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CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . . . L. W. MARSHALL, Manager
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EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

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TELEGRAPH EXTENSION.

It was announced recently that the southern branch of the projected Cape to Cairo telegraph line has reached Lake Tanganyika. The latter part of the line is through German East Africa, and there is still another section through the same territory before British territory will again be reached. The extension of this telegraph line, a large section of which runs through the roughest country, is the entering wedge of civilization. It is to be followed by a railway system, and in this way the heart of Africa is to be opened.

Just at this time the report of this extension in Africa is particularly interesting, since it comes just when events of an opposite character are happening in another part of the world. One of the most marvelous developments of recent times has been the gathering and distributing of news throughout the world by means of the telegraph. Of late, a good part of this news has come from Russia, where great events are taking place. But now, due to the refusal of the telegraph employés to work, the outside world is practically shut off from all Russian news, except what can be sent through by means of couriers. This is an unprecedented situation, for apparently the telegraph systems have not been destroyed, but lack only for operators.

TESTING ELECTRICAL MACHINERY.

Electricians always claimed that the means employed for testing electrical machinery were simpler and more accurate than those available for making corresponding mechanical tests. The ease with which electrical quantities are measured, and the accuracy of the measuring instruments are the chief factors in this work. When, however, electric dynamos or motors are to be tested the power at one side of the apparatus is mechanical, and not electrical, and must therefore be measured by some mechanical means. Methods of doing this have been devised, some of them fairly satisfactory, though, as a rule, they are rather difficult to use, and the desirability of avoiding any mechanical measurements is generally recognized, and has given rise to a number of schemes by which the efficiency of the apparatus to be tested can be determined closely, without any mechanical measurements being made. Two of these methods have become famous throughout the engineering world. The one known generally as the Hopkinson test consists in coupling together mechanically and electrically two similar machines. One of these machines is run as a generator, supplying its electrical output to the motor, which, in turn, employs its mechanical output in driving the generator. The losses of such an arrangement must, of course, be supplied from the outside, and originally this was done by means of a small engine driving the generator. The method may be applied more conveniently, however, reversed—that is to say, the losses may be supplied electrically, and thus be measured easily. The principle may be applied, making either of two assumptions. It may be accepted that the two machines are operating at the same efficiency. Knowing, then, the power being circulated and the losses, the efficiency of the system is at once determined, and the square root of this may be taken as the efficiency of each machine. The other plan is to assume that the losses in the two machines are the same. Knowing, then, the power circulated—that is to say, the output of the generator and the input of the motor—and charging each with one-half of the external input, the efficiencies of the two machines can be determined. The objections to this method of testing are, first, similar machines are required, and second, the two machines do not operate under just the same conditions. In large machines this difference in

loading does not affect the result so much as it does in smaller ones; for example, assuming that each machine has an efficiency of ninety per cent, the efficiency of the system would be eighty-one, and one machine would be carrying approximately twenty-five per cent more load than the other. The test, however, is a pretty one, and has been used widely, and is still generally adopted for making a temperature test of a machine, since a full load is thus obtained without any undue waste of energy.

The other method of testing, sometimes known as the stray power test, is due to Swinburne. It is based upon the assumption that the friction and core losses of a dynamo or motor are constant for fixed conditions of operation—that is to say, fixed voltage and speed. These can therefore be measured by running the machine idle as a motor. The total input is then employed in supplying the internal losses. Deducting the field loss and the loss due to armature resistance from the input leaves what is called the stray power. For any assumed output, then, the required input may be computed by adding to the output the measured stray power loss and the calculated resistance losses of both field and armature. This gives a very satisfactory means of arriving at the efficiency of a machine without actually loading it. It has the advantage that the losses, being small, can be measured accurately with small instruments, and an error made in this determination will have slight effect on the computed efficiency. If, for instance, the stray power loss were ten per cent at full load, an error of ten per cent in measuring this would amount to only one per cent in the computed efficiency. The disadvantage of the method is that it assumes a constant core loss, and makes no allowance for any losses due to commutation or field distortion when under load.

Various modifications of these two methods have been made, but all of them are open to the objections just stated. If a test of the machine under full-load conditions be insisted upon, nothing remains but to run it under such conditions, and measure either the mechanical input or output. There are various ways of doing this, but they are all open to the objection of inaccuracy, and are difficult to employ.

A recent method of testing small motors and dynamos under actual operating conditions has been devised by Dr. Charles V. Drysdale, of Northampton Institute, England. The device is a modification of the cradle dynamometer, and is an improvement over the old arrangement, in that the power is applied electrically, and not mechanically, to the machine. Dr. Drysdale has secured a special generator capable of operating under wide variations in speed. This has been mounted on ball bearings, and has a cradle attached, by means of which the torque exerted on the machine can be measured. By a convenient, adjustable table, the motor or dynamo to be tested is brought into line with this machine and directly coupled. The auxiliary testing machine can then be run either as a motor, drawing its supply from the main supply, or as a generator, being driven by the motor under test. In any case the mechanical power supplied to or delivered by the machine under test can be accurately measured. There is no belt to set up vibrations, a simple universal coupling makes the attaching of the two machines together easy, and the test is made under actual operating conditions. If desirable, power can be circulated between the two machines, without in any way affecting the result. The scheme is a satisfactory arrangement for testing motors or dynamos not varying too much in size. The correctness of the result will depend largely upon the care with which the machines are adjusted and the readings taken; and although the conditions for accurate measurements are good, it is probable that the accuracy of the result will be limited by the accuracy of the mechanical measurements. As a refined method of determining the performance of a machine, it is probably excellent, yet it is not a method adapted for general use.

While everyone will admit the desirability of accurate work, we should not lose sight of the fact that simplicity and convenience are of great importance, and a method applicable anywhere at any time to any machine will be preferred, and frequently will be used when a more accurate method might be employed. Then, too, it must not be overlooked that the value of a very careful and accurate test may be entirely vitiated by a slight change in the conditions. The voltage may not be just what was expected. It may be desirable to change the speed slightly, or perhaps the brushes may be shifted somewhat from their best position. In fact, a number of slight modifications in the running of a machine may change the losses, and thus the efficiency. When making the stray power test, it is a simple matter to determine the losses for a range of speeds and voltages. If this is once done, satisfactory figures for the efficiencies under varying conditions are easily obtained.

There is another method of testing machines which is widely used—that is to say, by means of a motor whose efficiency is known; but since the performance of this machine must itself be determined in some way or other, we are brought back to our original position. The accuracy of the results will, of course, depend upon the accuracy with which this motor has been tested.

THE ELECTRICAL FIRE HAZARD.

An interesting discussion took place recently, relating to the electrical fire hazard, during which at first there seemed to be a great divergence of opinion; but, as it later turned out, the opinions held by the two sides were not far apart. Those who took the side of the operating electric company wished for an expression of opinion regarding the relative risk of various illuminants. Those on the insurance side first said that a well-installed electric light system was the safest of all methods of illumination. This brought up the question of what is meant by a good installation, and how it is best to be obtained. The experience of those who took part in the discussion seemed to vary: what was accepted at one place would not be taken elsewhere as good work. Sometimes the requirements of the underwriters seemed too severe. On the other hand, it was held that although a good electrical installation is safe, a bad one is particularly dangerous. The greatest risk, it was said, is during the daytime, when no lights are in use, yet the pressure is main-

tained on the wiring. It was said that in the use of other illuminants—gas or oil, for example—there is always some one around when they are lit and able to start a fire. As against this argument it was urged that gas is always in the mains, and may leak out and cause an explosion the moment a light is produced. Gas, when a considerable leak occurs, always gives warning by its odor, and the workman must do a good job if his piping is to stand this test. Electric wiring, however, can be put in in bad shape and still give good light. Danger may exist, and can not be detected without careful inspection. There is no tell-tale evidence of such work until trouble occurs.

This view of the matter puts the responsibility upon the insurance and municipal inspectors. It is their business to see that the wiring is installed as it should be, and that it is safe. That their work is, in general, successful is indicated by figures quoted by a prominent electric light operator. He said that for New York state the percentage of fires due to electric wires was 3.67, while for New York city the electric fires were only 1.14 per cent of the total. These figures were supplemented by an insurance man, who said that a fair estimate would be to attribute two per cent of all the fires to electric wiring. These averages are pretty conclusive proof of the safety of electric lighting. They also show that credit must be given to the underwriters' code for helping to bring this condition about. Electric lighting is a comparatively new thing, and it has grown with marvelous rapidity. New apparatus and new methods are constantly being introduced, yet it is found that fires which can be attributed to electrical causes are not increasing as rapidly as the electrical systems are being developed. The general conclusion of the discussion was that a properly installed electrical system is safer than any other, but that careful work must be done and particularly careful inspection must be maintained to see that the workman does not slight his work. This requirement is not peculiar to electrical matters; is essential to all. Good material must be used, and good work must be done if a safe installation is to be obtained, no matter what the system. Given this, the electrical system is unsurpassed. Two per cent of all fires is surely a low figure for the electrical risk, yet we feel sure that even this will be reduced.

IMPROVING THE CONDITIONS OF EMPLOYER AND EMPLOYE.

One of the papers most interesting to the engineering fraternity at large which was read at this week's session of the American Society of Mechanical Engineers was that by H. F. J. Porter, on "The Realization of Ideals in Industrial Engineering." Mr. Porter points out the radical departure which has taken place in the condition of intimacy between employer and employé, due to the growing up of immense manufacturing corporations employing thousands of operatives of various classes. While the old-fashioned ideas made many things common to both employer and employé, leading the worker to take a keen interest in his task, Mr. Porter is of the opinion that with the right kind of management and consideration, men can be worked to-day to a higher efficiency, and the product materially improved. The considerations necessary for success in the modern industry are very intelligently pointed out, and the paper presents, on the whole, a most interesting discussion of this very vital question.

AN ELECTRIC ACCELEROMETER.

At a recent meeting of the electrical section of the Canadian Society of Civil Engineers, a paper was presented by Dr. R. B. Owens, professor of electrical engineering at McGill University, describing an ingenious and interesting accelerometer, devised by the author, which seems to possess some valuable features for engineering work.

About eight years ago Dr. Owens devised an electric-speed indicator, which has since been widely adopted. The operation of the indicator is based upon the speed characteristic of the magneto-generator or a machine having a constant field excitation. When such a machine is constructed so as to have small armature reaction, and is not overloaded, the speed-voltage characteristic is a straight line within a wide range of speeds. Such a machine, connected directly to a direct-current voltmeter, may be employed as a speed indicator, and by adjusting the resistance of the circuit, or by the choice of an instrument with a suitable scale, it may easily be made direct-reading. When used with care, it is as accurate as the instrument used with it allows. In fact, the most likely source of error is that due to careless reading of the meter or to careless calibration of the indicator.

In the present paper Dr. Owens shows how this speed indicator may be employed as an indicator of acceleration. Since the current delivered by the small generator is directly proportional to the speed, the change in value of this current is directly proportional to the change in speed—that is to say, the acceleration—so that a suitable arrangement for measuring this change in current gives us an accelerometer. Such an arrangement is secured by introducing into the circuit of the speed indicator the primary of a small transformer, and connecting the secondary of this to the terminals of a direct-current voltmeter. When a suitable ratio of transformation is selected, which must be fairly large, since the changes to be measured are small, a satisfactory deflection is obtained, and the voltmeter reads accelerations directly.

These two devices have been put to excellent use already, and have given satisfactory results. Until recently, little attention was paid to means of determining speed, and although accurate instruments for measuring currents and voltages were provided, the student was left to do the best he could with a small speed counter and a watch, and the best done in this way was often far from satisfactory—in fact, the accuracy of the work was generally limited by that with which the speed readings were taken. More attention has been paid to this matter of late, and electrical engineers have demanded more satisfactory apparatus for speed measurements. A number of devices have been proposed, that due to Dr. Owens being one of the first. To-day the importance of acceleration measurements, particularly for tramway work, has made the accurate measurement of this quantity important, and Dr. Owens's adaptation of his speed indicator to perform this service adds a very acceptable instrument to the equipment of the engineer.

THE ELECTRICAL NATURE OF MATTER AND RADIOACTIVITY.

BY HARRY C. JONES.

CHAPTER XII.

Emanation from Radioactive Substances.

We have already seen that all radioactive substances give off α particles, which are positively charged, material bodies. All radioactive substances, with the exception of polonium, give off β particles, which are negative charges of electricity or electrons, having the same mass as the negative charges in the cathode ray, *i. e.*, about 1/770 of the mass of the hydrogen ion in solution. All radioactive substances which give off β particles also give off α rays. This includes all radioactive substances, with the exception of polonium. The γ rays are identical with the X-rays, except that they are far more penetrating.

We have also seen that radium gives out continuously large quantities of heat. Since this production of heat energy is due mainly to the α particles, it seems fair to assume that all radioactive substances that give off α particles, and this, as was just stated, includes them all, also give off heat energy. In the case of the weakly radioactive elements, such as uranium and thorium, the number of α particles given off is relatively small, and, therefore, the amount of heat energy given off by them is relatively slight. It may, indeed, be so slight as to escape detection.

In addition to these three kinds of radiations, and the heat energy, certain radioactive substances such as thorium, radium and actinium give off what Rutherford calls an *emanation*. This substance, as we shall see, resembles in many respects a gas. It can diffuse through porous substances, can be condensed at low temperature, etc. It has the properties of the radioactive substances from which it was obtained.

DISCOVERY OF THE EMANATION BY RUTHERFORD.

The amount of the emanation given off even by radium is small, and for some time escaped detection. We owe its discovery in fact to the study of the radioactivity of thorium. It had been observed by Mme. Curie and others that the radioactivity of thorium was not constant when the thorium compound was placed in a vessel exposed to the air. If the compound of thorium, on the other hand, was placed in a closed vessel, constant results could be obtained. It was found that the lack of constant results in open vessels was due to air currents. If a current of air was drawn through the closed vessel containing the thorium, inconstant results were again obtained. Rutherford took up the study of the cause of this irregularity, and the result was the discovery of the emanation.

METHOD OF OBTAINING THE EMANATION.

The emanation can be obtained from the salts of radium by simply heating them, or by dissolving them in water, when it is given off. It can be collected in a vessel like any other gas, and its properties studied. Before taking up its general physical and chemical properties, one property especially will be discussed in some detail, since it practically demonstrates the gaseous nature of this substance. The emanation can be condensed at low temperatures, like an ordinary gas, into a liquid.

If hydrogen is allowed to bubble through a solution of a radium salt, and is then passed through a U-tube surrounded by liquid air, the emanation condenses in the tube. Similar results are obtained if the products expelled by heating a radium salt are passed through a U-tube dipped in liquid air.

If only a small amount of the radium salt is available, the condensation of the emanation is shown by the fact that the escaping hydrogen is either not radioactive at all, or only slightly so; while the emanation is extremely radioactive. If a larger amount of the emanation is obtainable, its presence in the cold glass tube can be seen; not by producing under ordinary conditions a visible amount of liquid, but by a fluorescence in the air in the cold tube, and also by rendering the walls of the tube brilliantly fluorescent.

By a modification of the above-described experiment, it is possible to determine the temperature at which the emanation condenses or boils. A mixture of the emanation and the neutral gas is passed through the tube cooled down below the temperature at which the emanation condenses. When the emanation was all condensed the escaping gas, hydrogen, oxygen, nitrogen or air showed no radioactivity when tested by the electrical method. After all the emanation had been condensed a current of neutral gas, say hydrogen, was passed through the tube containing the emanation. The temperature in the condensing tube gradually rose, due to the presence of the warmer gas, and when the boiling-point of the emanation was reached and a little of it was volatilized, its radioactivity manifested itself in deflecting the electrometer with which the vessel into which the emanation passed was connected. When this took place, the temperature in the condensing vessel was read by means of a copper resistance thermometer, that had been previously calibrated.

The average result from a number of experiments showed that the emanation condenses at — 152 degrees centigrade. This point was fairly sharply determined by the fact that the ionization or conductivity of the gas into which the escaping emanation passed, reached a maximum shortly after the emanation began to volatilize, and when the temperature had been raised only a very slight amount.

The emanation thus condenses to a liquid just like a gas, and like a gas has a perfectly definite boiling-point.

AMOUNT OF THE EMANATION.

The amount of the emanation obtainable even from an appreciable quantity of radium is very small indeed. If the emanation that can be obtained from a tenth of a gramme of radium chloride or bromide, is condensed in a glass tube as previously described, no liquid or even mist will be seen in any part of the tube. All that will be seen is a fluorescence on the walls of the tube, and this may extend through the neutral gas within the tube.

Sir William Ramsay and Soddy have measured approximately the volume of the emanation obtainable from a given quantity of the radium salt. The emanation was collected in a capillary tube which had been graduated, and measured.

From sixty milligrammes of radium bromide they obtained 0.124 cubic millimetre of the gas. This volume *decreased rapidly with time*, and we shall learn that this is a very important fact. After one day the volume of the above emanation was only 0.027 cubic millimetre. After six days it was only 0.0063 cubic millimetre, while after twelve days it had shrunk to 0.0011 cubic millimetre.

NATURE OF THE EMANATION.

In studying the properties of the emanation we encounter the great difficulty, which at present is insurmountable, that it can not be obtained in appreciable quantity. This is especially true of the emanation from thorium, as might be expected from the small radioactivity of this element. We have just seen that the emanation from radium disappears, or "decays," as it is said, quite rapidly. This is especially true of the emanation from thorium, which is not only infinitesimal in quantity, but disappears or decays in a few minutes. The emanation from radium, however, does not entirely decay for a number of days.

The emanation itself is unaffected by a

magnetic field, and is, therefore, not charged. It can, however, produce fluorescence in certain substances.

After having shown that the emanation has many of the properties of gases, and is certainly material in nature, attempts were made to identify it with some of the known forms of matter. Its chemistry was carefully studied. It was subjected to *very high temperatures,* but was unaffected by this treatment. Then it was passed through a platinum tube heated as highly as the nature of the tube would permit. It was also passed over heated platinum black, and escaped in both cases without change. In the above experiments the emanation was mixed with air. It was then mixed with hydrogen and passed over red-hot magnesium powder, and also over red-hot palladium, but it was still unaffected.

The emanation was also subjected to the most vigorous chemical treatment. Ramsay sparked a mixture of the emanation with oxygen, for a long time, in the presence of an alkali, and also heated it in the presence of magnesia lime, but the emanation was unchanged. The emanation thus differs from all known forms of matter, except argon and the other members of this group of elements, which are characterized by their chemical inertness.

While we do not know, even at present, very much about the chemistry of the emanation, it seems safe to conclude that if it is an element it belongs to that inactive group of chemical elements of which argon was the first member to be discovered, but of which helium has the smallest atomic mass. Even if it should be shown *not* to be elementary, it nevertheless resembles in its chemical properties the elements of this group.

Some light has been thrown on the *physical properties* of the emanation, notwithstanding the fact that it has been obtained only in such small quantities.

DIFFUSION OF THE EMANATION—APPROXIMATE DETERMINATION OF ITS MOLECULAR WEIGHT.

It is well known that gases diffuse with very different velocities. If we allow gases of different densities to diffuse into any gas, say the atmospheric air, we will find not only that they will diffuse with very different velocities, but a regularity will manifest itself. The lighter gases will diffuse more rapidly than the heavier ones.

If we work quantitatively, we will find a very simple relation between the densities or the molecular weights of gases, and the rates at which they will diffuse.

GASES DIFFUSE WITH VELOCITIES THAT ARE INVERSELY PROPORTIONAL TO THE SQUARE ROOTS OF THEIR DENSITIES.

This generalization, known from its discoverer as the law of Graham, is comprehensive, holding for all well-known gases.

Upon the basis of this generalization, Rutherford has attempted to determine approximately the molecular weight of the emanation from radioactive substances, notwithstanding the fact that the largest amount of the emanation thus far obtained is scarcely weighable even with the most refined chemical balance.

The determination of the approximate molecular weight of the emanation was made as follows: A metal tube, about three-fourths of a metre long and six centimetres wide, is closed in the middle by a movable metallic septum. Two insulated metallic rods, each nearly half the length of the tube, are passed each through an ebonite stopper, and inserted into the tube. Each end of the tube is closed by one of the stoppers. The walls of the metal tube are connected with one pole of a battery, and charged several hundred volts. The metal rods are connected with electrometers, which, like the other pole of the battery, are connected to earth. The metal cylinder is insulated, surrounded by some poor conductor of heat, and placed in a box filled with cotton wool to keep the temperature as nearly constant as possible. Each end of the metal tube is connected with the air by capillary tubes, which will maintain the same air-pressure inside and outside of the tube, even when the emanation mixed with air is being introduced into one end of the metal tube; and at the same time does not allow much diffusion to take place through them. When it was desired to introduce the emanation, the metal septum between the two halves of the metal tube was closed, and a current of air passed through a platinum tube containing the radium salt, which, in turn, was connected with one end of the metal tube. The platinum tube and its contents were heated, and the emanation mixed with air, was passed into one arm of the metal tube.

The tube was now allowed to stand for some time until temperature equilibrium was established, when the metal septum between the two halves of the tube was removed. The emanation mixed with air now diffused from the half of the tube into which it was originally introduced, over into the other half. The current in the two halves of the tube was measured at regular intervals. In the half into which the emanation was originally introduced, the current gradually became less and less, due to loss of emanation to the other half. In the second half the current gradually became greater and greater, as more and more of the emanation diffused over into this part of the tube. Finally, after standing for a number of hours, the current in the two halves of the tube was nearly the same, showing that the emanation had diffused from the end of the tube into which it was originally introduced, over into the other end, until the whole contents of the tube was practically homogeneous.

From the data thus obtainable the diffusion coefficient of radium could easily be calculated.

The experiments which, on the whole, were the most satisfactory and probably the most accurate, gave a diffusion coefficient which was close to 0.07.

If we compare this coefficient with the diffusion coefficients of vapors whose molecular weights are known, we find that it comes close to the coefficient for ether, which has the value of 0.077, and the molecular weight of ether is 74. The molecular weight of the emanation from radium must, therefore, be close to 74. All things considered, Rutherford seems to think that the molecular weight of the radium emanation is not far from 100, and is probably even somewhat greater than this number. The emanation from thorium was shown to have practically the same molecular weight as the emanation from radium.

Since the above determinations of the molecular weight of the radium emanation were made by Rutherford, new determinations have been carried out by Makower, working with J. J. Thomson.

Before the work of Makower was published, some observations were made by Curie and Danne on the rate at which the emanation diffuses through capillary tubes having different lengths and diameters. They obtained results for the molecular weight of the emanation that corresponded with the lower values found by Rutherford and Brooks. The measurements by Makower were made as follows:

Radium bromide was dissolved in water and the emanation removed by passing air through the solution. The mixture of air and the emanation was collected over mercury in one arm of a glass vessel resembling a Hempel burette, which was closed at the top by a porous plug. This vessel, known as the diffusion vessel, was connected with a cylindrical brass vessel. Into the centre of this brass

cylinder a brass rod was introduced, so as to be insulated from the walls of the vessel. By means of a storage battery of two hundred cells, a difference in potential of about four hundred volts was established between the brass rod and the walls of the box. A known volume of the mixture of air and the emanation was introduced from the diffusion vessel into the brass cylinder, and the conductivity of the gases in the cylinder determined. As soon as the conductivity had been determined, the emanation was quickly pumped out of the cylinder, so as to minimize the amount of the "induced radioactivity" on the walls of the vessel, which quickly decayed.

The mixture of air and the emanation now gradually diffused out of the diffusion vessel, through the porous plug. From time to time fresh quantities of the mixture were driven over from the diffusion vessel into the brass cylinder and its conductivity determined. As more and more of the emanation diffused out through the porous plug in the top of one arm of the diffusion vessel, the conductivity of the mixture remaining in the vessel became less and less, as was shown by testing the conductivity at short intervals, by the method already described. In this way it was not difficult to determine the rate at which the emanation diffused out through the porous plug.

To determine the molecular weight of the emanation, it was necessary to compare its rate of diffusion with that of gases whose molecular weights were known, diffusing through the same porous plug. The gases employed were oxygen, hydrogen, carbon dioxide and sulphur dioxide. The gas was introduced into the diffusion vessel and allowed to diffuse out into the atmosphere. Knowing the molecular weights of the gases, the rates at which they diffuse through the given porous plug, and the rate at which the emanation diffuses through the same plug, we can calculate the molecular weight of the emanation from Graham's law.

The results showed a molecular weight for the radium emanation ranging from 85.5 to 99. On the assumption that the radium emanation is a monatomic gas, Makower points out that this result would give it a place in the Periodic System in the fluorine group between molybdenum and ruthenium.

The molecular weight of the emanation from thorium was found to be slightly smaller than that from radium.

These results show that the molecular weight of the emanation is very nearly one hundred, as Rutherford had supposed.

A Large Steam Turbine Generator.

The requisites of a successful design of a steam-turbine-driven generator have been discussed by Mr. B. A. Behrend, who describes a recently completed generator of this type. The machine was built for direct-connection to a turbine turning at 750 revolutions per minute. It is rated at 5,500 kilowatts and for either 6,600 or 11,000 volts. It is further required that the generator must be capable of standing 6,880 kilowatts continuously without the temperature rising more than forty-five degrees centigrade; and 8,250 kilowatts for three hours, without a rise of more than fifty-five degrees centigrade. The peripheral speed of the rotating surface of this machine is nearly 15,000 feet per minute. Under such conditions of speed the centrifugal force assumes a tremendous magnitude, and the careful distribution and calculation of the stresses and strains in the different members of the rotating magnetic field become a matter of the utmost importance. An investigation conducted by the author some time ago showed that the stresses are a maximum on the inside boundary of the armature discs. The structure of the rotating field consists of ten nickel-steel forgings pressed on a nickel-steel shaft. In order to obtain good permeability and good mechanical strength, the alloy contained from three to five per cent of nickel. Its lowest elastic limit is 50,000 pounds per square inch, and its ultimate strength 80,000 pounds. The highest stress of the rotating element in this case does not exceed 15,000 pounds per square inch, so that at abnormal speeds the lowest factor of safety is almost five and one-half. The difficult problem of fastening the field windings securely was met by constructing these windings of flat copper strips, wound on specially designed formers. These coils are lodged in regular slots milled into the nickel-steel discs, and are held in place by retaining-wedges made from Parsons manganese bronze. The end connections of the field coils rest against nickel-steel end-rings. The electrical efficiency of this generator, as obtained from tests, is 94.4 per cent on one-quarter load; 97 per cent at one-half load; 97.9 per cent at three-quarter load; 98.3 per cent at full load; 98.5 per cent at one and one-quarter load; and 98.6 per cent at one and one-half load. The regulation of the generator at full load and 100 per cent power-factor is seven and one-half per cent. Another question of great importance in the design and operation of the high-speed, revolving-field generators is created by the tendency toward vibration. By carefully studying the problem and choosing such dimensions of the shaft of the machine as will correspond to a natural vibration of the rotating element, as much different as possible from the period of vibration produced by unbalancing at the normal rotative speed, it is possible to obtain safe and steady operation without fear of vibration.—*Electrical Age (New York), November.*

Chicago Electrical Show.

It is announced that more than one-half of the available floor space in the Coliseum, Chicago, Ill., has already been contracted for for exhibition purposes at the electrical exhibition to be held from January 15 to January 27, 1906. Three thousand square feet are allotted to the schools and colleges throughout the Middle West having technical departments, and each school will display some novel test or demonstration. This department of the electrical show will be in charge of Dr. Henry Crew, professor of physics at Northwestern University; Clarence E. Freeman, professor of electrical engineering at Armour Institute; Charles H. Smith, editor of *School Science and Mathematics;* R. A. Milliken, of the University of Chicago, and Professor P. B. Woodworth, head of the technical department of Lewis Institute.

During the exposition there will be several conventions in Chicago, including those of the Northwestern Electrical Association and the Electrical Salesmen's Association.

The 200th anniversary of the birth of Benjamin Franklin—January 17—will be devoted to special features.

Among the companies contracting for space, in addition to the sixty-two announced quite recently, are the following: Electric Launch Company, D. B. Southard, H. A. Petersen Manufacturing Company, John A. Roebling's Sons Company, American Electric Sign Company, Chicago Compound Battery Company, American Circular Loom Company and the Nungesser Electric Battery Company.

The New York Electrical Show.

Among the features of the electrical show to be held at Madison Square Garden, New York city, December 12-23, will be a wireless bulletin service which will be maintained in the Garden throughout the exhibition. News items and happenings on the various steamships equipped with the De Forest wireless apparatus will be transmitted from the exhibit to the surrounding cities. Among the wireless apparatus to be shown will be the mechanisms used in the Japanese-Russian war, and demonstrations will be made of the apparatus now in use on the American merchantmen and battleships.

The exhibit will include an electric automobile equipped with sending and receiving wireless apparatus. These cars have been used for reporting sporting events, and are intended for this purpose, as well as for army use.

The Mechanical Equipment of the Hotel Gotham.

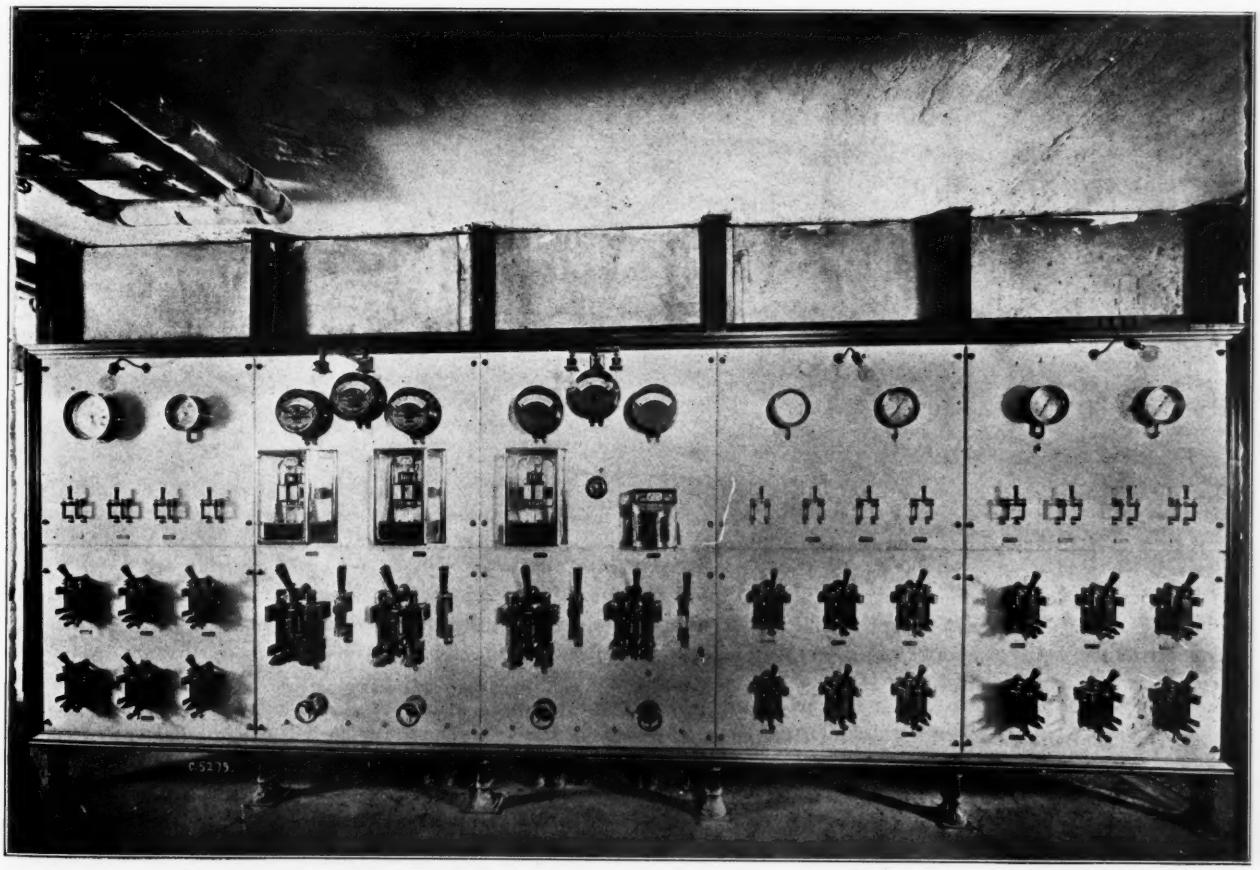
A Modern Hotel Equipped with Electricity for Illumination and the Driving of Auxiliaries.

AT the southwest corner of Fifty-fifth street and Fifth avenue, New York city, there has been erected, at a cost of about $3,000,000, a modern hotel designated as the Gotham. Catering to a fashionable patronage, the appointments have been laid out with the idea of securing the greatest possible comfort, in addition to æsthetic embellishment. The hotel is equipped with its own electrical and mechanical installation, the apparatus in this case being particularly compact and self-contained. The building is of fireproof construction throughout, twenty-one stories high, and all of the main power equipment is arranged in the basement of the building.

A plan of the basement is shown herewith, from which it will be easy to follow the general scheme of arrangements. Coal is delivered to the bunkers through several chutes from the Fifty-fifth street side, and from these bunkers the fuel is conveyed on an industrial railway to the front of the furnaces, where it is manually delivered to the boilers. Bogie trucks are also run on this railway, which convey the ashes in cans from the ash-pits to a switch located in the northwest corner of the basement, and from this point the cans are lifted by a hoist to the sidewalk and emptied into carts.

FIFTY-FIFTH STREET ENTRANCE, HOTEL GOTHAM, NEW YORK CITY.

Five 200-horse-power boilers of the Manning type supply steam at 100 pounds pressure, with a back pressure of three pounds. The boilers are connected by seven-inch bends to a twelve-inch header, which runs the entire length of the boiler room. Connected at right angles to this header is a twelve-inch, high-pressure steam main, which runs into the engine room and supplies the engines and elevator pumps. Leaving the engine room, the high-pressure main continues as a six-inch main for feeding the auxiliary apparatus. The large main and header are fitted with valves, so that any boiler may be isolated, and, in addition, a six-inch gate valve is provided where the high-pressure main changes from a twelve-inch to a six-inch line. From the six-inch main line feeding the auxiliary apparatus, a four-inch branch is taken off, which connects through a two-inch by-pass with the exhaust pipe. A Ford pressure-reducing valve, receiving a pressure of 100 pounds,



SWITCHBOARD, ELECTRICAL EQUIPMENT, HOTEL GOTHAM, NEW YORK CITY.

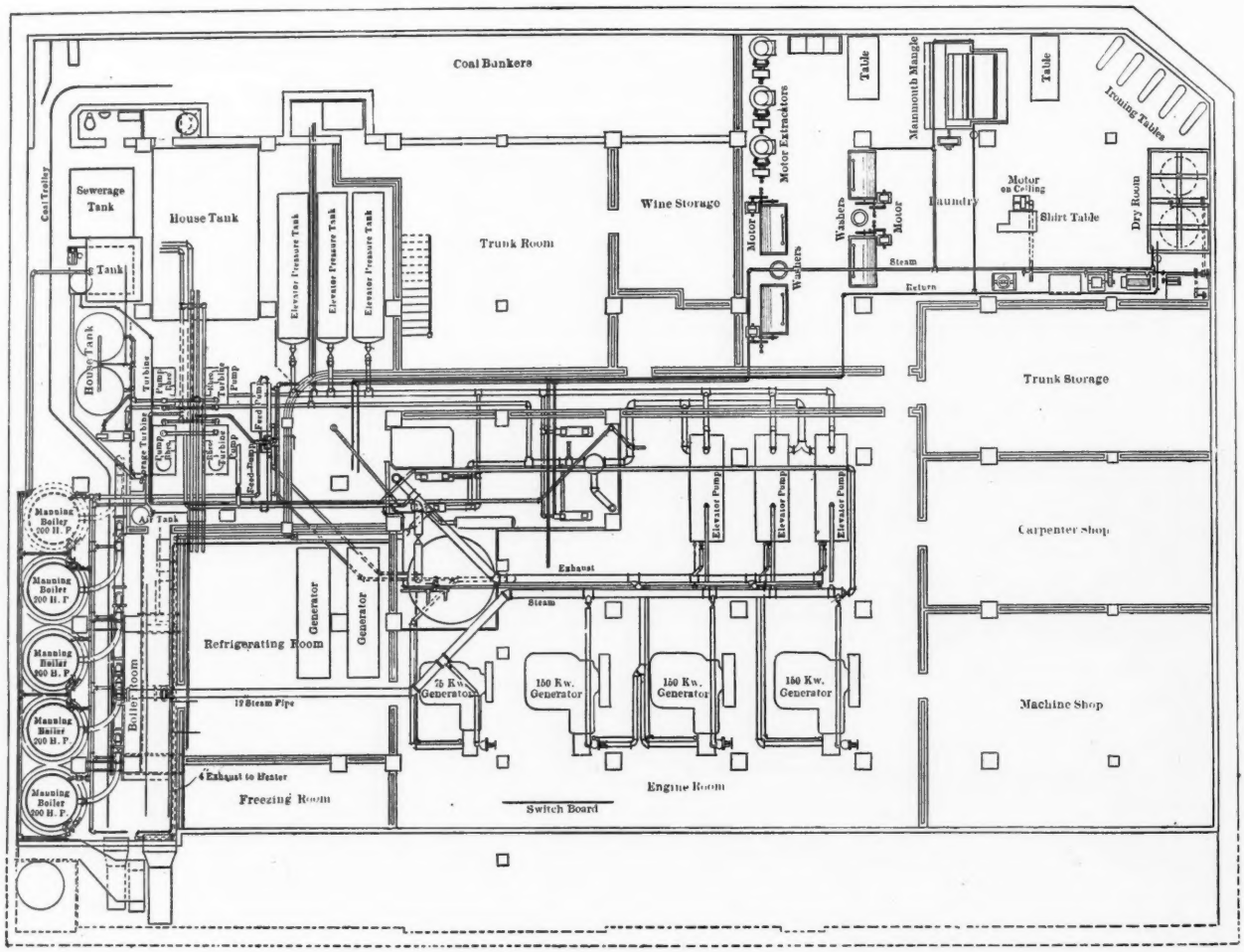
and delivering a pressure of forty pounds, is introduced into the four-inch main, this valve being provided with a by-pass.

There are two horizontal feed-water heaters of the seamless brass water-tube type, each of 300-horse-power rating. The exhaust steam comes in at the top, and there are drip connections at the bottom and a supplementary high-pressure steam connection.

Branches are run from the main to each of the steam pumps, and to each of the electric generating sets. These are six inches in diameter, and each branch is equipped with a valve close to the main plates, water-trays, flanges, manholes and water columns. There is a twelve-inch steam inlet, and on the four-inch return there are two-inch drainage outlets and standard manholes. The by-pass is arranged across the top of the tank, fitted with gate valves.

From the muffler tank the exhaust extends to the bottom of the exhaust reservoir, with a drop leg. A twelve-inch supply pipe is connected to this line, feeding two branches to the two feed-water heaters, and one branch with a flange-connection to the header of the refrigerating system generators. All steam risers are ernor controlling the two boiler feed pumps. The oil drips from the engines and pumps are caught up and conveyed through a one and one-half-inch drip main running beside the exhaust pipe. This drip main is enlarged to two inches at the muffler tank, and a branch leads into the oil chamber and into the return chamber of the muffler tank. At the twentieth floor there are T and gate valves for the heating system, back-pressure valves and the exhaust head.

There is a two and one-half-inch blow-off for each boiler, emptying into a three-inch main.



MECHANICAL PLANT OF THE HOTEL GOTHAM, NEW YORK CITY. LAYOUT OF APPARATUS IN BASEMENT.

and with a throttling valve at the engine. The piping of the boiler feed pumps is cross-connected for both generator and hand control. The main exhaust pipe is located in a trench in the engine room, and is twelve inches in diameter. This rises with a long bend beside the muffler tank. This muffler tank is of special construction, containing the muffler, grease extractor, return tank and feed-water heater connections on the Baldwin system. It is fitted with diaphragm, baffle-

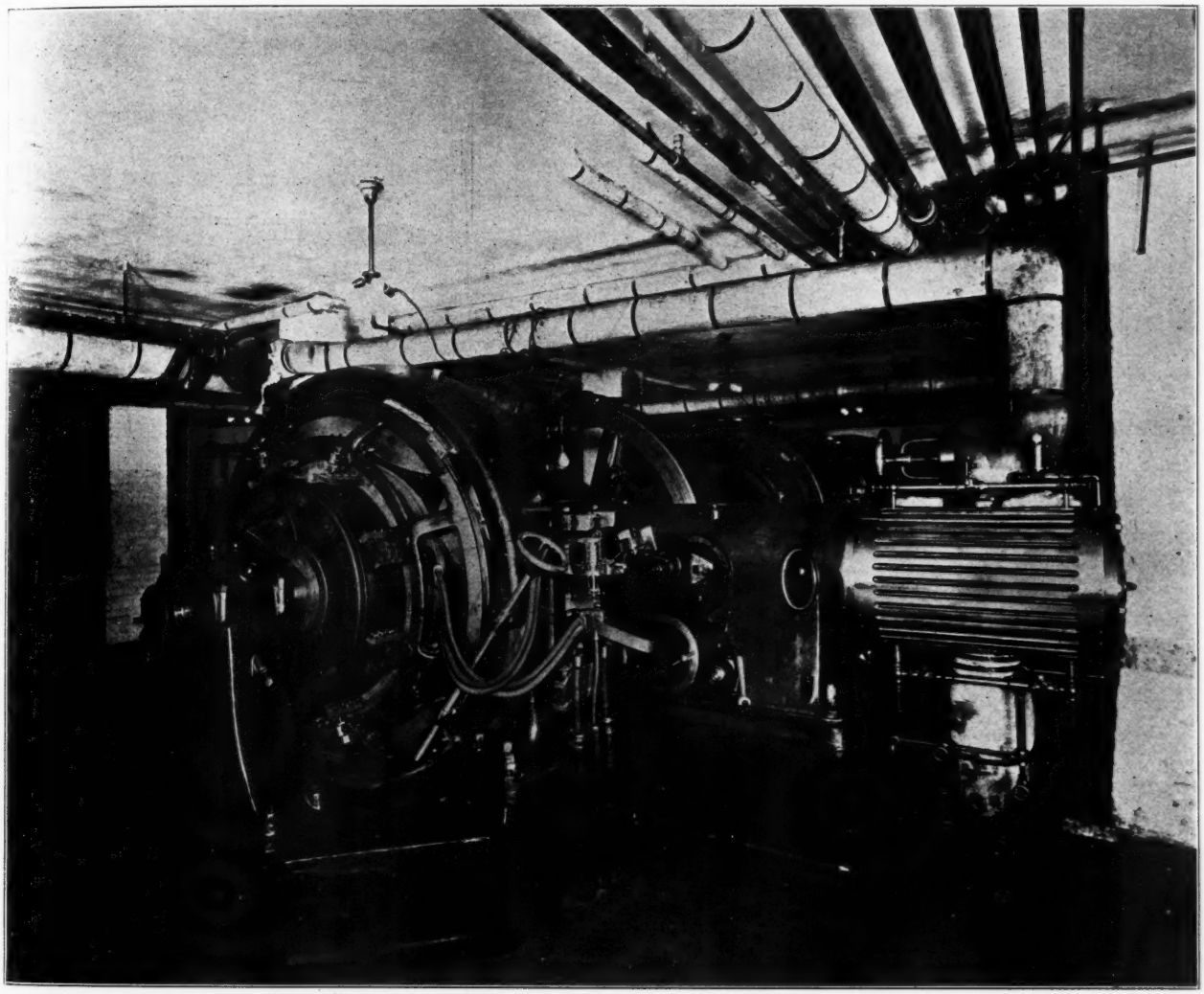
equipped with expansion joints on the ninth floor, two elbows, two twelve-foot lengths of pipe, and a return bend. The risers are clamped in the basement and at the fourth and fourteenth floors only. All of the pipes are covered with eighty-five per cent magnesia covering, with canvas jackets and Russia iron bands. Each steam outlet is equipped with Reliance safety water columns with combined high and low-pressure alarm. There is also a one and one-half-inch Ford pipe gov-

The boiler feed-water is taken from the city mains. A four-inch main runs from the return chamber through a pump governor to the boiler feed pumps, and a four-inch main is connected with the suction tank. The sump pumps are connected with suctions running to the blow-off tank.

The four generating sets are located in the engine room. The generators are all compound-wound machines, built by the Sprague Electric Company. Three of these are of 160 kilowatts capacity, and

one is of seventy-five kilowatts capacity. Direct current is generated at 240 volts potential. Direct-connected, non-condensing engines, built by the Ball Engine Company, drive the generators. The light and power service is operated on a two-wire, 225-volt system.

A polished white Italian marble switchboard made up of five panels enclosed in a bronze frame and built by the Crouse-Hinds Company, Syracuse, N. Y., is located in the engine room. The back is encased in a screen, and all connections are carried out through copper buses to a pull-off box running the entire length of the top of the switchboard. As may be seen from the illustration, the layout of the board is as follows: panel No. 1, distributing switches; panel No. 2 and panel No. 3, generator panels; panel No. 4 and panel No. 5 are for service switches. The two generator panels, each contains two double-pole circuit-breakers, two single-pole knife switches for the equalizer connections, two recording wattmeters, two rheostat handles for the generator rheostats on the back of the board, two ammeters and one voltmeter. A multiple voltmeter is provided as a ground detector. The switchboard is also equipped with a clock and with a high-pressure steam gauge up to 150 pounds, intermediate to 100 pounds. There is also a low-pressure steam gauge reading to fifteen pounds. There is an air-pressure gauge reading to 300 pounds, and a similar air-pressure gauge reading to 150 pounds. All of the circuits are controlled by "I-T-E" circuit-breakers, with the exception of a few small fifty-ampere switches.



A View in the Engine Room of the Hotel Gotham, New York City.

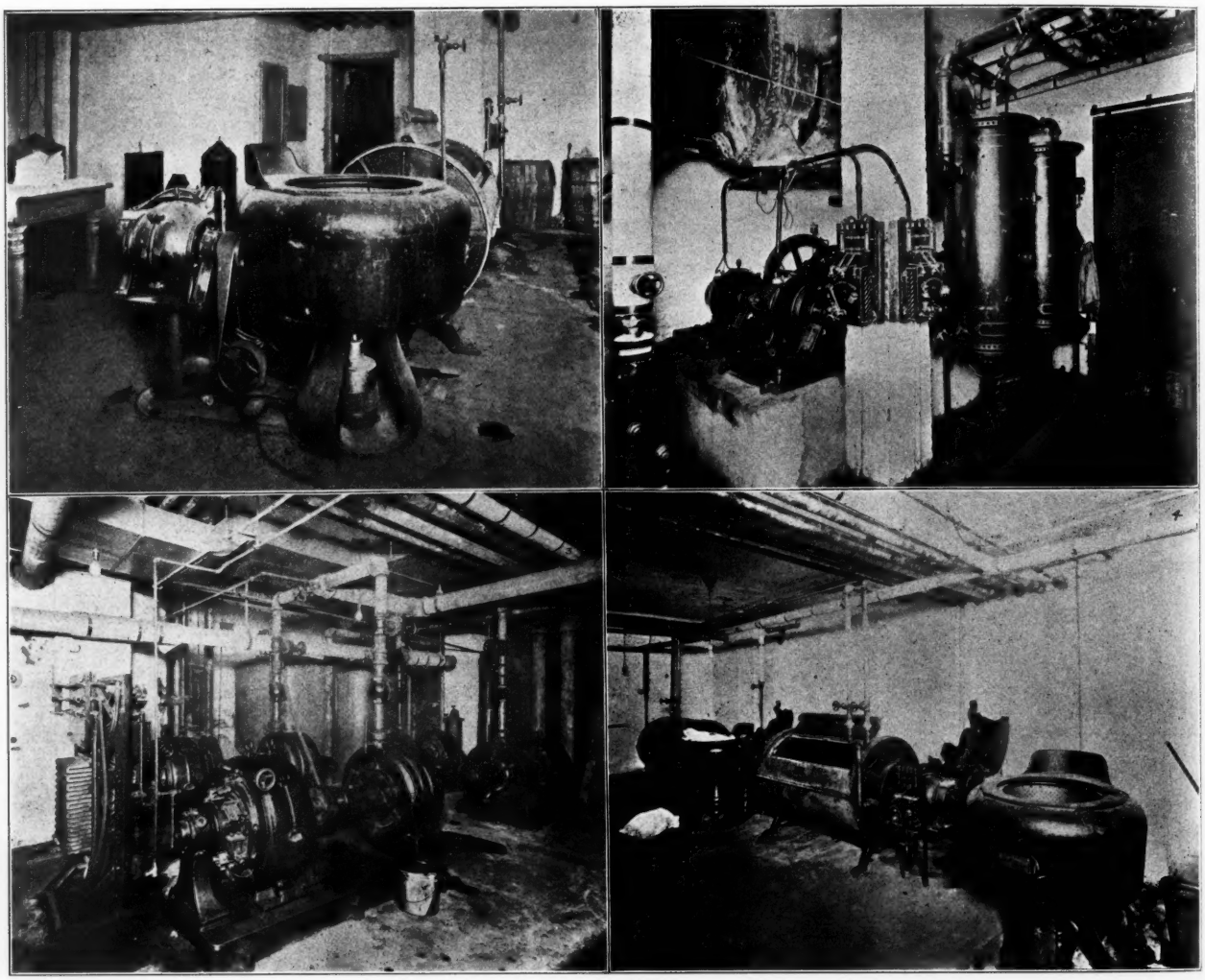
The wiring system of the hotel is practically arranged in three divisions. There is a working or service division, a public division and the apartment or bedroom division. The apartment division takes in practically everything above the first or second floor, the basement and cellar being devoted to service, including kitchen and serving rooms, storage rooms, and the machinery. The public division will include the café, restaurant, ballroom, palm garden and other similar departments of the hotel. Cluster fixtures are used in the kitchen and serving rooms, supplemented by drops, and the engine room, boiler house, pump room and machinery rooms are also lighted by drops and ceiling clusters. The lighting of the public portion is carried out on elaborate lines, and many novelties and interesting features are introduced in this division. Candelabra and miniature lamps figure very largely in the ornamentation of the ballroom and the café, and the restaurant is embellished with ceiling and bracket fixtures, supplemented by individual lights for the tables. Attachment plugs are provided for the individual lights in the restaurant. There are something like 6,000 incandescent lamps, the greater portion of these being of sixteen candle-power. For the miniature lamps, and some of the

individual lamps, smaller candle-power lamps are used.

The motors for the auxiliary equipment were supplied by the Sprague Electric Company, and portions of the installation may be understood from the accompanying illustrations. The mangle is driven by a three-horse-power, compound-wound motor, and there are four washing machines, each driven by a one-horse-power shunt motor. There are three wringers, each driven by a one-horse-power shunt motor. There is a five-horse-power shunt motor driving a group of machines for doing laundry work. In the kitchen there are a two and one-half-horse-power motor running a freezer, a two and one-half-horse-power ice saw and chopper and a one-half-horse-power General Electric meat chopper. There is also a one-half-horse-power motor on the silver-buffing machine, and a one-half-horse-power Thomson-Houston motor connected to the dish-washer.

Two three-stage centrifugal pumps are driven by forty-horse-power Sprague motors. There are two two-stage centrifugal pumps driven by twenty-horse-power Sprague motors. The three-stage pumps have a capacity of 200 gallons per minute against 150 pounds pressure, and the two-stage pumps have a capacity of 170 gallons per minute against 100 pounds pressure. There are two Lawrence centrifugal pumps with a capacity of 100 gallons per minute against a twelve-inch head, each driven by a three-horse-power, direct-connected motor.

The fan equipment of the hotel for ventilating and other purposes is noteworthy. There are seven forty-two-inch cone fans running at 150 revolutions per minute, each driven by a one-horse-power motor. There are two ninety-inch exhaust fans, running at 120 revolutions per minute, with four-horse-power motors. There is one seventy-inch fan running at 135 revolutions per minute, equipped with a three-horse-power motor. There are four sixty-inch fans running at 200 revolutions per minute, equipped with two-horse-power motors; one fifty-inch and one forty-eight-inch fan running at 500 revolutions per minute, driven by one-horse-power motors; two twenty-four-inch fans, running at 500 revolutions per minute, equipped with a one-half-horse-power motor, and two eighteen-inch fans running at 500 revolutions per minute, driven by a one-quarter-horse-power-motor. All of the wiring for light and power, call-bells and telephones, is enclosed in "Loricated" conduit. The panel-boards for the distribution circuits are of three-quarter-inch white marble, encased in iron boxes provided with lugs for the attachment of the face panels and doors.



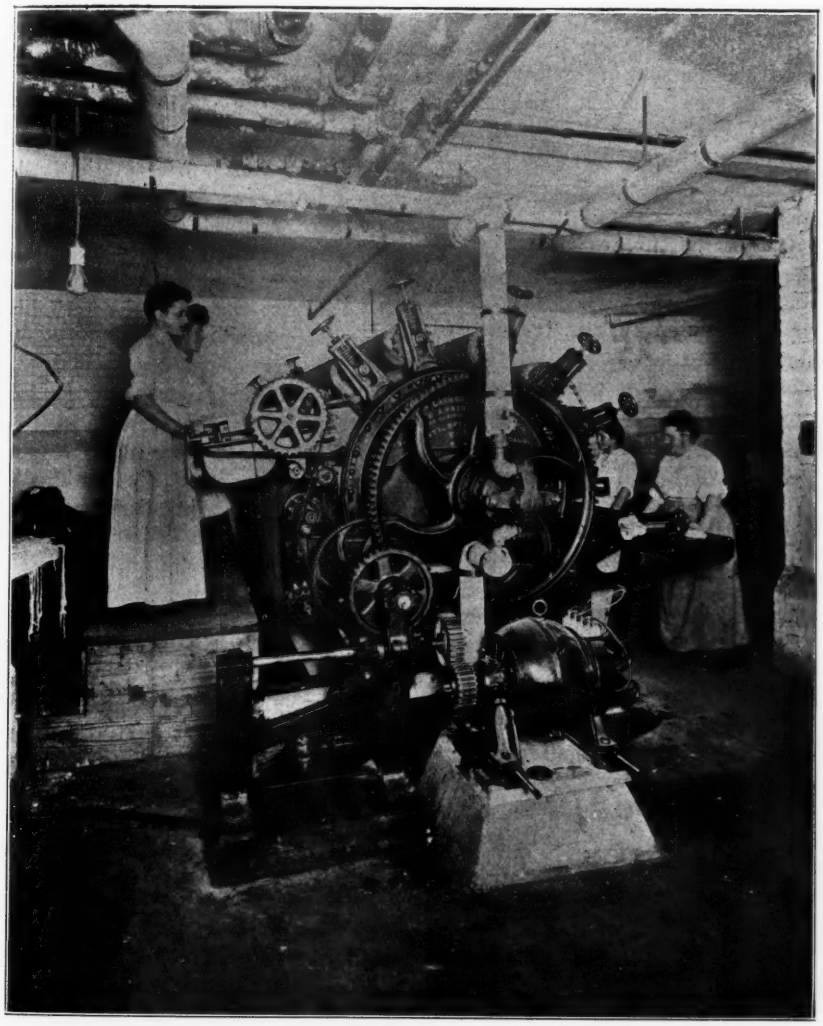
MECHANICAL EQUIPMENT, HOTEL GOTHAM, NEW YORK CITY. 1—MOTOR-DRIVEN EXTRACTOR. 2—VACUUM CLEANING MACHINES. 3—HOUSE AND FIRE PUMPS. 4—MOTOR-DRIVEN WASHER.

The electrical fixtures were supplied by E. F. Caldwell & Company, and the bath-rooms are equipped with 325 Simplex Electrical Heating Company's electrical curling-iron heaters. The watchman's clock apparatus was supplied by the E.

Howard Clock Company. The elevators are of the standard Plunger Elevator Company's make. There are four elevators running to the top of the house, and one running to the ballroom. There are five service elevators made by the Burdette-Roundtree Company.

The vacuum cleaning apparatus is driven by two five-horse-power motors. The air line is taken off from standards on the various floors, and the suction apparatus simply moved about from place to place, as required.

In the ornate cornice at the upper part of the building there is a live-steam pipe, which is fitted with one-inch outlets at various points for melting the snow. On the roof of the house there are two house tanks, one of 7,500 gallons capacity, and one of 3,600 gallons capacity. The elevator suction tank has a capacity of 7,600 gallons. The cold-water tank has a capacity of 800 gallons. There is a brine tank eight feet by two feet, and a distilled water tank eight feet by two feet. In the cellar there is a house tank with a suction of 21,800 gallons. There is a blow-off tank with a capacity of 4,200 gallons, and a distilled water tank with a capacity of 3,000 gallons. The elevator pressure tanks are eighteen feet by four feet, and six feet high. There are six of these elevator pressure tanks. The intermediate house-pressure tank is round in form and is ten feet high by six feet in diameter. The 350-pound air-pressure tank is eight feet high and thirty inches in diameter. The 175-pound air-pressure tank is nine feet high by thirty-six inches in diameter. There is also one drip tank three feet high by four feet in diameter, and a sewage tank eight feet by eight feet by five feet.



MOTOR-DRIVEN MANGLE, LAUNDRY OF THE HOTEL GOTHAM, NEW YORK CITY.

The building was erected by the general contractors, the General Building and Construction Company, of New York, which is also part owner of the hotel. The electrical work was under the direction of the Contractors' Electrical Company, of Brooklyn, N. Y. The Baldwin Engineering Company, of New York, was the contractor for the steam and heating equipment.

National Conference on Standard Electrical Rules.

The third general meeting of the National Conference on Standard Electrical Rules was held at the Edison Auditorium, No. 44 West Twenty-seventh street, New York city, on the afternoon of Monday, December 4. This conference was first organized in 1896, when the first meeting was held in New York city. It consists of delegates from the national associations interested in electrical matters, who form the active membership. Associate members are admitted from operating and manufacturing electrical concerns. The second meeting of the conference was held in Boston, April 21, 1905. At this time it was decided that the conference could be best kept in efficient condition if meetings were held yearly, and it was deemed desirable that they should be held about the time of the annual meeting of the Underwriters' National Electric Association, at which time changes in the National Code are considered.

The third meeting was called to order at 2.30 P. M. by President W. J. Hammer. The first matter to come before the meeting was the report of the secretary and treasurer, Mr. C. J. H. Woodbury, who stated that after all bills had been paid, there was a balance on hand of about thirty-eight dollars. The conference then took up the consideration of a constitution and by-laws presented by a special committee. These seemed desirable, since the conference intended now to hold yearly meetings. The constitution was adopted with a few amendments. It defines the objects of the conference, and states that active members shall be delegates from the national associations interested in electrical matters, and associate members, as previously defined, appointed by manufacturing and operating companies. The dues were fixed at $20 a year, and it was decided that a meeting should be called annually about the time of the meeting of the Underwriters' National Electric Association, and that the executive committee, which is made up of all active members, should call special meetings whenever it was thought desirable. This decision was only reached after some discussion, a number of those present believing that the authority of the conference would be best maintained if matters of

less importance were left to the executive committee, and that a general meeting be called only when something of especial importance had come up. It is questioned also whether the conference should meet before or after the meeting of the Underwriters' National Electric Association. Should the conference meet before, it would act as an advisory body, but would have to consider all changes in the code which had been proposed. If, on the other hand, it met after the Underwriters' association, it would then be too late for it to effect any immediate change in the code. It was pointed out that the suggested changes were generally made by one or two persons, and that but few of them are adopted.

The executive committee nominated officers as follows: president, W. H. Blood, Jr., Seattle Electric Company, Seattle, Wash.; secretary and treasurer, C. J. H. Woodbury, American Telephone and Telegraph Company, Boston, Mass. These gentlemen were elected.

During the meeting a number of matters were discussed pertaining to the relations of the underwriters and operating electrical companies. A resolution was adopted calling the attention of the underwriters to the undesirable prominence some think is given to its published list of fires. It was asked that some method be found for overcoming this. This produced a somewhat extended discussion of the relative risks of various illuminants.

The following important resolutions were adopted:

"*Resolved,* That it is the sense of this conference that the grounding of low-tension secondary alternating-current systems be strongly recommended in all cases wherever reliable grounding connections can be secured.

"*Resolved,* That in cases of three-wire systems with grounded neutral, solid connection, without fuse, be permitted on the neutral wire.

"*Resolved,* That it is the sense of this conference that the grounding of secondary alternating-current systems inside of buildings on water-pipes, provided such connection is made at nearest point to cellar wall on water-pipe, and outside of meter, is not only safe, but places no additional burden or menace upon such water-pipes."

A graceful action was taken by this conference in asking Mr. Hammer, the retiring president, to remain a member of the conference, and resolutions were adopted expressing appreciation of his past work and thanking him for his untiring efforts in behalf of the interests of the conference.

THE REALIZATION OF IDEALS IN INDUSTRIAL ENGINEERING.[1]

BY H. F. J. PORTER.

1. In the specialization process evolved by the severe competition in the industrial world during the past half century, engineering has possibly suffered as much cleavage as any of the other professions. Our section of mechanical engineering was one of the earliest results of this action, and through the fostering influence of the technical school which came into existence almost simultaneously, it prospered and rapidly assumed characteristic features which were readily distinguishable. Seeming to include the essentials required by manufacturing industry, which was steadily growing and at the same time becoming continuously diversified, this section in turn responded to the pressure of the refining process yielding many subdivisions.

2. One of the most recent of the latter developments has been accorded considerable attention by this society at its recent meetings, although as its scope and limitations have not as yet had time to become defined it does not seem to have reached an exact status. Its adherents therefore responding to their individual preferences or qualifications gained by personal experience have individually assumed titles illustrative of the line of their immediate practice, such as industrial, commercial, organizing, manufacturing, production, and modernizing engineers. The "Engineering Index" classifies literature written by these men under the caption of industrial economy. Colleges have established departments intended and destined to embrace the fundamental principles of the new profession under the name of schools of commerce.

3. Some of the experts in this field devote their attention to perfecting office and accounting systems and making methods of organization and management more efficient, while others are engaged in the refinement of processes of manufacture and shop practice in order to simplify and increase production and reduce its cost; and inasmuch as office and shop are very intimately related these lines of work frequently cross and overlap each other.

4. These men are doing work as to the necessity of which there is no question. They have come into existence in response to an urgent demand and the efficacy of their work in meeting it is evident wherever it is performed. Their efforts are directed toward the scientific study of problems in office and shop practice, the economic value of which has been heretofore overlooked. There is as yet no book which treats of the whole field of their activity although there are many monographs covering the special features of their practice. There is, however, in these latter writings an acknowledgment of the basic fact that, to secure the ultimate efficiency of the working organizations in both office and shop, the human element in each must be accorded recognition.

5. It is this feature of the broad field of what I shall here term industrial engineering that I desire to bring to the attention of the society in this paper, and I do not think the subject has been referred to except parenthetically at any previous meeting. We have insensibly drifted away from the patriarchal system of management which existed as late as twenty-five or thirty years ago, in which the owner of a shop was manager, superintendent and workman, who knew little about shop organization, but associated with his men on intimate and cordial terms. As manufacturing plants have grown in size and the workmen have differentiated their trades, a type of military organization has gradually developed in the shops in which the manager, superintendent and foremen are officers who instead of being expected to take part in turning out the product of the plant are, on the contrary, experts in shop management, and see that the machine of which the workmen are parts is kept in proper working order. In this way the old personal touch between master and men (which terms still adhere in English shops) has disappeared entirely. But human nature has not changed. That element still exsists in the organization, and if the full strength of the latter is to be secured it must be accorded recognition. The writers above mentioned say that no matter how perfect may be an accounting system, if it is carelessly or unintelligently applied it becomes worse than worthless because it will be misleading in its results; that no matter how perfectly suited to their purpose the machines or efficient in quality or shape the cutting tools, unless they are skilfully manipulated the product will be unsatisfactory, and so in either case the outcome of an enterprise possessing mediocre talent in its working forces will be jeopardized. In order then to ensure a successful issue to a manufacturing venture we must look beyond the mechanical

[1] Presented at the New York meeting (December 5-8, 1905) of the American Society of Mechanical Engineers.

assets to the qualifications for efficient service possessed by the organization of supervisors, clerks and operatives; and it will be found that the measure of success attained will be determined by the standard of excellence of these qualifications.

6. I do not wish, however, to be understood as underrating the value of a high grade mechanical equipment, for if success is to be attained the equipment must be the best of its kind for the purpose. But I do wish to emphasize the greater necessity of possessing as highly efficient an organization as can be secured; for a capable organization can make the best of a poor equipment and produce good results, whereas an incapable organization will not only fail to make a fine equipment productive of good work but probably in a short time will destroy the equipment itself.

7. In his paper on shop management, presented at the Saratoga meeting in June, 1903, Mr. Fred W. Taylor quotes the attitude on this point taken by Mr. Carnegie, whom he designates as having been one of the most successful manufacturers of this country, and therefore to be considered as an authority on organization and management. Mr. Carnegie, when asked by a number of financiers whether he thought that the difference between one style of organization and another amounted to much, providing the company had an up-to-date plant properly located, said in effect that should some great catastrophe destroy all of his mills but spare his organization, which had required many years to perfect, he might be inconvenienced temporarily but that he could depend upon his organization to reestablish his business. If, however, he should lose his organization, even if his mills which were the best in existence were left intact, he would not have time nor strength to rehabilitate himself in the business world. Just as we have, for instance, recently seen it demonstrated that opposing armies and navies may have exactly the same guns, but that the side which has behind those guns the men of superior physique, character, intelligence and skill will win the battle, so also it has been proven that it is not the tool that determines either the quantity or quality of product, but the qualifications for efficiency possessed by the man behind the tool who controls and directs it.

8. The lesson taught generally by the foremost enterprises of the day, in their respective industries, is that their success has been largely due to the efficiency of their working forces. Thus in recent years the importance of possessing a high grade organization has impressed itself more and more upon the mind of the business manager, so that at the present time this possession is considered, by those who are most competent to judge, by far the most valuable of all commercial assets.

9. Considering for a moment the functions of the organization, together with its circumscribing limitations, it must be recognized initially that if one man autocratically dominates it its scope of expansion can never be any greater than what he can himself devise. Also that the character of work which may be realized from the organization as a whole will be no better than can be produced by the individuals that compose it.

If honest workmanship is desired, honest workers will be necessary for its accomplishment; if quantity of output is expected, skill and enthusiastic devotion to duty must be possessed by the operatives; if improvement in processes and perfection of product are to be hoped for, the workers must have intelligence and be given suitable opportunities for its expression; if the organization as a whole is expected to grow, not only in size but in strength and character, facilities must be offered for the improvement of the individuals and inducements made for taking advantage of them; if untiring aggressiveness against competition is desired, absolute confidence in the enterprise and its product will have to be developed in the organization, and if harmonious cooperation between departments and management is to be effected, a spirit of mutual helpfulness must be imbued in the individuals comprising them respectively.

What then are the qualifications with which a high grade organization should be endowed in order to attain a high standard of efficiency? Inasmuch as, after all, an organization is but a collection of human beings, it stands to reason that if as an entity it is to be of high grade the units of which it is composed must also be of that grade. As, however, no two organizations are governed in their formation by similar conditions, each case presents a problem *sui generis* for the manager to solve, but every case will be found ultimately to consist in a study of human nature in its many phases, and this, we have been told, "is the proper study of mankind."

10. The attributes which human beings possess in common fall into three classes, viz.: physical, moral and mental. Those belonging to one or another of these classes may predominate in men following different pursuits in life, but in any manufacturing enterprise it is evident that the physical attributes are the most important. No matter how moral or intellectual a man may be, if he is a weakling, if he has not health, he can not be an efficient part of an active organization. First of all, therefore, the members of the organization must have health, they must be strong and vigorous.

11. Next he must be of high character, for no matter how healthy or intelligent a man may be if he is immoral, *i. e.*, if he is dissipated, if his time outside of his working hours is given over to intemperance, gambling, or other forms of vice, his condition, physically and mentally, while at work can not be such as to qualify him as an efficient member of a high grade organization. His physical and mental powers are gradually affected, his sense of responsibility weakens, he becomes irregular in attendance, careless in attention to his duties, and can not be depended upon.

12. And, finally, it is evident that given a man of good physique and strong character, the higher his intelligence and skill in the direction of his duties the better qualified he will be to accomplish his daily tasks, but it is also evident from the preceding considerations that important as are these latter qualifications they must be subordinate to the other two and considered last in relative importance.

13. Now, I claim that the ordinary system of management in selecting and maintaining an organization, reverses the order in which the value of these qualifications for membership is estimated.

The questions usually asked an applicant for employment are:

First. Have you had a college education?

Second. What has been your practical experience?

Third. Have you ever been discharged? If so, what for?

Fourth. Give a list of people for whom you have worked.

Occasionally: are you a drinking man?

But the self-estimate of what constitutes a drinking man makes the answer of little worth, and scarcely any interest is aroused by the amount of evasion displayed by the applicant.

14. Now, although we have seen that the human asset is of greater importance in an industrial enterprise than its mechanical possessions, I think I can safely say that infinitely more pains are taken in obtaining a machine or tool, to see that it is covered by detailed specifications and inspected during construction and before acceptance than is given to securing the man who will be put in charge of it and

held accountable for results from it afterward. Experts from at least one department and frequently from several are consulted, and much time and thought are devoted to the consideration of the machine, and after it has been secured and becomes a listed possession considerable care is devoted to lessening its subsequent depreciation and it is never discarded without protracted debate and calculation. On the other hand, we rarely hear of a recognized labor or employment department in a shop, and when there is one it is seldom intelligently administered. Usually little care is taken in the selection of the men, and no thought is given to their improvement during their time of service. They are taken on and laid off without a thought of consideration for their welfare or convenience, and they frequently live with a sword of Damocles hanging over them, continuously expecting on any pay-day to find their discharge ticket in their envelope. No men can work at their best efficiency under these conditions.

15. Now there is one marked difference between machines and the men who operate them which should be noted here. Machines, no matter how well they may be cared for, depreciate from five to ten per cent per year owing to the advent of other and improved machines, while men, if they are properly cared for, may appreciate in value several hundred per cent in the same time. Yet I maintain that as a general rule machines and tools are nurtured, fostered and preserved long after their period of usefulness has expired, while the permanency of service of the men of the organization who operate them receives comparatively no consideration whatever. It can not be expected that the men of an organization will show any spontaneous enthusiasm for interest in or loyalty to a management that openly displays so little interest in their welfare.

16. I think these statements are facts based on the aphorism that the exception proves the rule. For there are exceptions so conspicuous as to make the rank and file of manufacturing concerns in this regard seem commonplace.

17. I do not, however, wish to find fault with the care which is generally taken in the selection and preservation of equipment, nor do I wish to be considered as casting reflections upon the lack of consideration for the men that has existed in the past.

18. Our ideas about the treatment of men by those in authority have undergone a vast change in the past few years. We are, for instance, only now beginning to realize that it pays better to educate our criminals than to keep them in solitary confinement, and our state money is being directed toward making our penal institutions places where the inmates will receive instruction and be surrounded by influences which will make them good citizens after incarceration instead of imposing punishment upon them for the useless object of satisfying revenge, which treatment having been found to develop resentment tends to increase rather than diminish the criminal proclivity.

19. Huxley says: "There are two opposing methods at work in the government of the world, respectively, the ethical and the cosmic. The practice of that which is ethically best involves a course of conduct which in all respects is opposed to that which leads to success in the cosmic struggle for existence. In place of thrusting aside or treading down all opposition it requires that the individual shall not merely respect but help his fellows. Its influence is therefore directed not so much to the survival of the fittest, but the fitting of as many as possible to survive."

20. The tendency of the times now is directed away from the cosmic and toward the ethical method of management in industrial and commercial affairs. We are beginning to realize that no success counts which is obtained at the expense of others. That no triumph is a real one which is attained by pulling others down or by keeping them down. In fact, that no life is worth very much which does not consider the welfare of others. The United States government for the first time at any industrial exposition exhibited at St. Louis last year a large number of photographs and pamphlets descriptive of methods of industrial betterment adopted by leading manufacturing concerns in this country, thus showing the present trend of thought in this direction. The United States bureau of labor in its report of 1904 dwells especially on the increase in the number of concerns which have taken this advanced stand. Teachers of political economy in colleges, leading clergymen, lawyers, statesmen everywhere are advocating the adoption of ethical principles in business dealings. President Roosevelt voices this sentiment in his advocacy of giving the other fellow "the square deal," which after all is only a modern way of expressing the golden rule which political and social economists all say is the most practical rule of life ever enunciated.

21. The study of cause and effect in the example set by those concerns which have applied these principles has demonstrated that they pay in a financial way. This latter fact comes as a surprise to many, but so also did the fact that model tenement-houses pay better in the long run than those of the old type. That establishments which have adopted these methods are continuing to apply them and are extending their application is significant that they are pleased with their results. On these general principles is founded the work which is the function of many industrial and civic betterment associations in this country and abroad. One of these, the Institute of Social Service, established in New York in 1898, collaborates with similar institutions in the principal countries of Europe and in Japan and keeps on file photographs, drawings, pamphlets and books, illustrating and describing schemes of industrial betterment, plans of industrial villages, improved housings for employés, methods of heating, ventilating and lighting shops, means of preserving health in unwholesome occupations, methods of preventing accidents by machinery and all cognate subjects. The failures as well as the successes are exhibited as warnings and examples respectively.

22. The National Civic Federation has established local industrial betterment branches about the country with the object of encouraging manufacturing concerns to adopt the most approved methods of organization and management in the hope of bringing about a better feeling between employer and employé. An effort in this latter direction must be at the foundation of every individual movement on the part of any manufacturing concern which desires to advance along modern lines. It is only reasonable to suppose that if employer and employé work together for a common end the enterprise will pay better than if each works for his own interest simply with the full persuasion that the other is trying to get out of him all he can. Cooperation must supplant antagonism to secure a full meed of success. So also of two competing concerns that one which gains the closest cooperation of its working organization, other things being equal, will have just that much advantage in its race for supremacy. The same law will govern the commercial supremacy of nations.

23. Mr. Alfred Moseley, a rich philanthropist of England, exercised over the threatened commercial supremacy of his country by our industrial advance, brought here in 1902 over twenty labor-leaders of different industries to investi-

gate the difference between American and English industrial practice.

24. His visits were naturally confined to the representative shops in the principal cities and his report stated that his observations led him to note the superiority of our methods—first, of wage payment, largely by one or another of the merit systems, based on the principle that a certain portion of the factory space was occupied by each workman, that that space represented a certain amount of invested capital, and as the fixed charges on it were the same whether the workman did much or little, the more work he did the better it would be for the company, and if he was paid properly the better it would be for him; second, of encouragement offered to develop the initiative of the workman and to get him to suggest improvements by paying a premium on them; and third, of having the individual workman operate as many machines as he could handle, and when new and more efficient machines come on the market the scrapping of the old ones, although they may be comparatively new.

25. Mr. Carnegie has coined the happy simile that successful industry is a partnership of labor, capital and brains; like a three-legged stool, the legs of which are of equal strength, no one superior to the other. And Mr. Moseley emphasized the advantage that we obtained in our works by encouraging the workmen to use their brains, and by developing and utilizing the enormous amount of expert knowledge possessed by the workmen, which was not only totally neglected in England but absolutely suppressed by the attitude of the foreman, who feared that their positions would be in jeopardy if a workman showed that he had any originality.

26. But Mr. Moseley and his party did not have time to stray very far from the beaten path, and saw principally the large and representative and successful plants. There are thousands which have not as yet advanced to the state he has described.

27. Influenced, however, by the example of the leaders in thought and action, many of the latter have recently experienced a change of sentiment and sought the cooperation of their employés. The change of attitude from one of mutual suspicion to one of mutual respect and confidence is not however effected either readily or rapidly. Traditions can not be destroyed by a simple dictum. Misunderstandings occur in the transfer which delay or offset the proceedings. Some concerns have become discouraged and have discontinued the attempt; others, however, have succeeded and are proud of their achievement. There is a right way to go about it and there are many wrong ways. Care must be taken that the right kind of people representing the management and the men are selected to accomplish the result.

28. Alexander Hamilton said more than a century ago, "A government must be fitted to a nation much as a coat to the individual; and consequently what may be good at Philadelphia may be bad at Paris and ridiculed at St. Petersburgh." Similarly a system of shop management which is suited to one industrial enterprise may work only indifferently in another and be a complete failure in a third. This statement may seem to be trite and unnecessary, but I know from my own experience that as long as men are constituted as they are, and they have probably not changed much since the time of Hamilton, whenever unusual conditions develop in a shop under any form of management, suggestions as to remedies which have been successful elsewhere are at once made by people who are well-meaning, but have no knowledge of the actual situation. This is empirical, and Mr. Charles Francis Adams, of Boston, in a recent paper on industrial conference, says that "in these (industrial) matters empiracy is of all things to be shunned." What is needed is a careful study by those whose knowledge of the conditions as they exist constitutes them as most competent to analyze the situation and deduce proper methods of procedure.

29. In any manufacturing enterprise a standing committee on which both employés and management are represented, which meets at stated intervals, is an excellent method of "getting together" those who are competent to act that each may see the other side of the shield and obtain the other's point of view.

30. There are frequent occasions arising when the management is anxious to know what attitude the employés would take in case a change in policy is made. On the other hand, the employés from time to time wish to lay a request before the management. In either case some temporary device is usually resorted to to meet the occasion. When a standing committee exits, however, a channel of communication is always open and each side keeps thoroughly in touch with the other on all matters of common interest. An honor system is thereby established among the employés and the discipline improves greatly. I have never failed to see a marked change come over the entire organization as it rose to its responsibility as soon as the members felt that they were accorded recognition as rational beings and to be consulted on matters of common interest. Generally the rank and file of the working organization is considered in the same category as the privates in an army, they are not supposed to think but to do as some one above them has planned. The usual result, as might be expected, is that they do not use their brains for the benefit of the concern.

31. All questions regarding systems of wage payments should come before the standing committee. The introduction of any of the various merit systems can be brought about in a shop with little difficulty if the subject is intelligently discussed by the committee in advance. In this country an appeal to reason is always accorded sympathetic reception, whereas the forcible application of a policy based on general assumptions meets with merited resistance. And I should say here that as all men work primarily for their support the wage question is the one which must be settled first and satisfactorily before any schemes of industrial betterment can be effectively developed. Men work for wages, and will go where they can get the most pay. But of two concerns, each paying the same wage, the one which extends the better treatment to its employés will be favored by the applicants for employment and by judicious methods it can obtain the better class of help.

32. Some work of common interest must be developed to engage the attention of the standing committee and the subcommittees which later may be appointed to handle details. The suggestion system now so generally adopted by the foremost concerns is a good subject for the committee to handle. This system develops in the operatives the power to observe, improves their capacity of initiative and inspires their ambition. It has besides the great advantage of being in itself a paying institution both to the employé and the company, when the latter pays well for valuable suggestions. A recent magazine article over the name of the welfare manager of the National Cash Register Company, which has probably gone into industrial betterment projects deeper than any concern in this country, says that this system will net his company the neat sum of $30,000 this year.

33. This system may include suggestions from the employés regarding improvements in their own conditions of comfort and work. No one knows better than the workman himself if he is not

working under the most comfortable circumstances, but he will naturally hesitate to complain. Yet every one knows that a man when comfortable can do better work than when he is uncomfortable, and should be given an opportunity to express himself regarding his condition.

34. The system should also include suggestions regarding improvements in processes and methods of work. The operative, if encouraged to think, will soon effect great savings in the work at which he is more of an expert than any one else who is not constantly engaged at it. I have recently seen a product considerably redesigned, the process of manufacture simplified and made much cheaper and the company put upon its feet largely through the introduction of the suggestion system.

Meetings of the foremen should be held regularly, and instruction given to them in the proper handling and management of men to secure the best efficiency within the limits of fair and just treatment. It must be understood that in order to secure the best quality of work the mind of the worker must be as free as possible from worry about his position. Peace of mind can not be maintained while conditions exist which entail arbitrary discharge from service or unexpected reduction of wages, nagging by foremen who are affected by favoritism, ineffective facilities for service, unpleasant and unhealthful surroundings, danger of accidents from unguarded machinery, loss of life in inflammable buildings inadequately supplied with means of escape. On the contrary, credit should be given to each employé for every effort to do his part in advancing the interests of the company. A little encouragement at the right time will do much to arouse ambition and enthusiasm, without which nothing of moment is accomplished.

35. I have already shown that health, character and intelligence in the order named are the essentials to be sought for in selecting an employé and when found should be fostered and improved. First, then, efforts should be made to raise and maintain at a high grade the standard of health of the organization. Good health means capacity for work both in efficiency when at work and through increased regularity of attendance. Irregularity in attendance is one of the banes of good management and it can only be improved by a careful investigation into its causes and application of the proper remedy. Mutual benefit associations are now quite general, but those where either a doctor or trained nurse is engaged to instruct the employés how to prevent sickness as well as to administer prompt and effective treatment during incapacity for work are effective of increasing efficiency. Instruction how to live properly, how to cook simple food, how to eat, bathe and sleep, and warnings against the use of patented nostrums will tend to preserve the health of the organization and raise the regularity of attendance. The latter can also be effected by the payment of a bonus annually to those whose presence has met a certain percentage of regularity. A warm lunch will increase the efficiency of the organization during the afternoon and facilities for obtaining it should be offered. Means afforded for exercise and amusement in the open air at noon, especially when the occupation is confining and sedentary, will also have the same effect. The character of the individual should be a no less important consideration in the mind of the employer than his health. It is very necessary to know whether or not the employé can be relied upon in the quality of his workmanship and in his effect upon others in the organization. Some managers say that they are not interested in knowing what their employés do outside of working hours. Some employés say it is none of the manager's business what they do in their own time. When however what the employés do in their time affects what they do in their employer's time, then it may be to the latter's interest to look into such matters. What the employer should desire is to have as few changes take place in his organization as possible. Now it should be remembered that in every factory there are apt to be many operatives who because they are strangers in the locality or from reasons consequent to their condition and circumstances have no opportunities for social recreation and pleasures and no place to go after working hours. Therefore being more or less creatures of circumstances they drift into associations and habits which may be debasing in their tendencies. This sort of thing leads to a lowering of the status of the organization through association, if they remain in it, or to an unsettled state if there are many changes due to constant removals. The social instinct in man causes him to seek companionship and if opportunity is given the members of the organization to attend lectures and other social gatherings which are attractive and at the same time elevating in their tendency the whole fabric of the organization becomes homogeneous, of high grade and remains intact. And, finally, the education of the employé should receive the attention it deserves. Early opportunity should be seized to improve the mind of the employé as he grows. The wider his knowledge, the better he will perform his duties.

36. Apprenticeship schools in operation during working hours under the charge of a trained teacher are effective means of developing the mentality of the organization and at the same time of getting in close touch with the employé early in his career, and the longer he stays with the concern and the more money is spent on his improvement the more valuable he becomes as an asset and the greater the effort should be made to retain him in the organization. Schools should be established in the factory during evenings for the purpose of helping the employé to advance in the organization. Energy coupled with character and knowledge guided by tact and discretion will open the avenues of achievement. Care should be taken, however, not to coddle the organization. Coddling engenders weaklings. Extending opportunities so that the employés can help themselves develops self-reliance, self-respect, and, at the same time, regard for the management. Such a policy promotes a strong and healthy organization. Employés are quick to feel any interest in their welfare and as quick to reciprocate. To increase the efficiency of an organization so that each employé is not only a passenger in the enterprise but effectively pulls his own weight is the function of this new field of industrial engineering. To do this with a spirit of honesty and fair dealing between employer and employé is a delicate mission. It embraces a wide field of activity in the world of advance in which industry is the leading exponent. Apart from the practical results obtainable by the foregoing methods of management, lies the fact that it is by instituting only the highest methods that employers are utilizing their privilege as men and citizens to help in the march of mankind toward progress and enlightenment.

Papers on Substation Considerations.

The 202d meeting of the American Institute of Electrical Engineers will be held in the assembly room of the New York Edison Company, 44 West Twenty-seventh street, New York, on Friday, December 15, at 8.15 P. M. The following papers will be presented and discussed:

"Some Considerations Governing the Location of Railway Substations," by C. W. Ricker, associate; electrical superintendent of power stations, Interborough Rapid Transit Company, of New York.

"The Relation of Railway Substation Design to Its Operation," by Sidney W. Ashe, associate; associate professor of physics and electrical engineering, Brooklyn Polytechnic Institute, Brooklyn, N. Y.

THE ENGINEER IN MANUFACTURING INDUSTRIES.[1]

BY WALTER S. GRAFFAM, B. S.

Before explaining the position which the engineer holds in relation to manufacturing, whether he be engaged in the civil, mechanical, electrical, mining or chemical branches (in many instances the professional work overlapping to such an extent that it would be difficult to discriminate), it will be necessary to state what is meant by manufacturing industries.

In a broad sense, a manufacturing industry is one in which something is made or produced. Ordinarily, when we speak of these industries, we do not have in mind the manufacture or construction of steel bridges, battleships, locomotives, etc., but rather of smaller articles, such as machine tools and special machines, small and delicate apparatus, instruments of precision, articles of clothing (boots, shoes, etc.), food products, jewelry, typewriters, bicycles, automobiles and other products of the shop, the mill and the factory. It is this second class to which we have reference, although much of what is here discussed will apply equally well to both classes of industries.

The opportunities opening up to young engineers to-day are more numerous and varied than ever before. We find them entering almost every walk in life, from that of day laborer to that of general manager of works under large corporations. Why should there be noticeable such a range of vocation? It would seem that it is a natural consequence of the training which the engineer must undergo. This education is now reckoned among the broadest and soundest that can be had in the time usually allotted to preparation for one's life work. In speaking of the engineer in this connection we refer to one who has been liberally educated and technically trained in a thorough-going course of engineering instruction of at least four years' duration.

Before manufactures are established, it is necessary to settle upon something to manufacture. This implies that the inventor must have been previously in evidence along that line of industrial development. The inventor is not made for the occasion, but the occasion makes the inventor. By which we mean that very few inventions of real and permanent value are ever made by persons saying to themselves: "I guess I'll get up an invention"; and, thence setting to work to do so. An invention is almost always the direct result of some urgent need. John Doe, let us say, has a definite operation to perform on an article, which he is making, which necessity impels him to invent the appliance or machine with which to execute it. Or, he sees at once the need of utilizing waste or by-products, whereupon he endeavors to devise a machine or a process in order to put these into marketable condition. Inventions thus spring into existence from necessity; a few are good and worth financial backing and technical development; the many are really good for nothing.

There are new problems, on the other hand, arising in manufacturing establishments almost all the time. It requires inventive power and ability to solve them. The one man to whom all others look in this direction is generally the engineer. He has had the training which fits him to undertake such work. He is familiar primarily with mechanisms and the nature of mechanical movements. He has a knowledge of processes, methods, forces and the natural sciences, including chemistry and physics, electricity and magnetism, hydraulics, etc. He may bring to his aid all of these agencies in solving such problems. He understands, moreover, the nature of materials, their elasticity and resistance. An inventor need not necessarily have graduated from some engineering school. If he has been thus educated the chances of his success are greatly enhanced. His work will be more thorough because more complete and scientific. It will be more satisfactory, perhaps, also more simple and reliable. He will not be likely to spend half his life in following up some phantom, as perpetual motion, for instance.

It may appear that we have been using the term inventor as synonymous with designer. It is not so intended. The designer works up the inventor's idea and carries it through the next stage of development necessary for workshop production. He puts it into tangible shape so that it will be of value to the world. We have reference to two classes of designers—those who are employed in designing machinery, tools, appliances, etc.; and others who may be classed as artists, being engaged in designing textiles and textile fabrics and patterns, wall paper, jewelry, etc. The latter will not come under the present discussion. They are usually educated in special schools of design and industrial art. Their productions are more related to the art side of industry than to manufacturing.

The mechanical designer, as he may be called, is to be found in nearly all manufacturing establishments. In most instances he will be a graduate of some reputable engineering school. He will be trained to grapple with the new and difficult problems incident to building up manufacturing industries. He will know how to go to work, and to set about solving a problem in a rational and logical manner. He will be quick to discern where the fundamental principles may be applied, and recognize that it is with these that he must begin. In time he will have acquired power to master each successive step; otherwise, he can not arrive at any reasonable conclusion of the problems presented, which shall be at once satisfactory to inventor and designer. Similar preparatory work he has had to do under instruction in his engineering course, and it now comes into play.

Probably more than fifty per cent of the chief draughtsmen in our large manufacturing works are graduate engineers. They have come to occupy excellent positions of trust and responsibility, at good salaries. In several instances they have men under them for the final success of whose work in relation to their employer's interest they must, as inspector and supervisor, take the praise or blame, as the case may be. Mistakes made in their department not only affect themselves, as well as the employés who make them, but very materially concern the other departments of the establishment. A wrong dimension on a drawing, if allowed to pass, may cause the loss of hundreds of dollars to the firm, through having to throw out, in consequence, some large casting, for example, and causing delay in machines and processes which may mean forfeit money required to be paid for every day's delay in fulfilment of the contract. The position of chief draughtsman, therefore, is one which requires considerable executive ability and ceaseless vigilance.

Similar exacting requirements hold for the position of overseer or department foreman. His place is second only to that of superintendent. Here again we find many graduate engineers, managing and carrying on successfully the work of their respective departments, any one of which, in several manufacturing industries, is a good-sized establishment in itself. It is here that the engineer must have many of the qualities which go to make up the successful superintendent, general manager or president of the com-

[1] Superintendent of shops Thomas S. Clarkson Memorial School of Technology. Reprinted from the "Clarkson Bulletin," October.

pany. He must himself know how things should be done. Otherwise, he can not properly instruct his men with regard to getting out work, or the amount of time and material any given order should consume. He must have and continually exercise good judgment, and be able to make close estimates of cost of work. It is he to whom the superintendent goes for information when planning and starting some new project. Furthermore, such an overseer must be able to live up to his estimates, and to see that the work is executed within schedule time and estimated costs.

Above chief draughtsman and head foreman, in the organization for manufacturing, are men with years of experience as engineers, an increasing number of whom are technical graduates, filling positions of superintendent and general manager. These are the places of the greatest responsibility. They are or ought to be sought after by every engineer of ambition and ability who desires to make a success of the manufacturing work with which he may be connected.

It seems self-evident that the educated man, the trained engineer, should be the one best fitted for these and similar positions of great importance to the advancement of our manufacturing industries. The engineer has done and is doing, for the advancement of civilization, all that enlightened man may do within the province of his chosen field of work. He is becoming responsible for the welfare, safety and security of human life, as well as its betterment under the conditions of modern society; and to a far greater extent than many other professional men. As such he is a factor to be reckoned with in the present and future development of our national power. Why are such men, it may be asked, better fitted to occupy executive positions in manufacturing industries than those who have been otherwise trained? Examining the statistics of but one institution of learning, we find that about forty per cent of its graduates are in executive and administrative lines of work. The managers of public works, it may be noted, as of electric lighting, street railways, water and gas works, etc., are coming to be the picked men from among the successful graduates of engineering schools, as has also been noted in reference to the larger manufacturing industries.

The man in an executive position must have a broad training. He should be able to manage men and money, to discuss matters intelligently which are outside of his special sphere of work; and to meet those with whom he comes in contact (whose capital he has to handle) upon their own level, intellectually and socially, so that the influence exerted may be mutually uplifting, of benefit to master and man, to employer and employé. Evidence of professional ability and skill, together with breadth of culture, will create increased confidence in the judgment of such men, and in the conclusions reached and advice given in any case. Capacity for the correct presentation of ideas and projects, in the most skilful manner and fitting language, is also of the utmost importance. This requirement the graduate engineer should be able to fill, for his education and training in the representative technical schools have been such as to permit of nothing lax in this respect. In all of his courses of instruction, of reading and mathematical studies, of laboratory experiments, computations and designs, he has been thoroughly drilled in details and the accuracy of work.

Throughout his educational career, the engineering student is habitually confronted with the necessity of ascertaining the efficiency of operations, of processes and methods; that is, the value of the relations of cause and effect in the development of some work. He finds that efficiency is, in a sense, the measure of the value of the relation between these, the ratio of work put in to work given out. This is not only a vital point in the theory and practice of engineering, but holds equally true as a measure of the value of man's relation to his work in all phases of business.

In another sense, the efficiency of a manufacturing industry is the relation of its income to its outgo, or expense account. Such industrial efficiency, however, is made up of the efficiencies of all the departments. If one department of the establishment is affected and allowed to fall below the normal, it tends to reduce the efficiency of the whole. The man who can best analyze the situation, in any given instance, and determine the cause or causes of success or failure, as measured by high or low industrial efficiency, is, in all probability, the one who can apply to the solution of the problem his own training and experience.

Among the first things which the engineering student comes up against, so to speak, are thoroughness of work and completeness of records. In an institution as in a manufacturing establishment, tab must be kept on the operation and efficiency of men and of machinery, sometimes at frequent intervals. Wastes must be prevented and forethought exercised to do this. The conditions are similar to those which must be met by the manager of a successful business enterprise. They are exacted of him. If his early training has been such as to aid him in this respect, he is to that extent so much better equipped than his competitor.

One of the most familiar diagrams to the engineer is that of a curve, plotted on squared paper, to show the relation between two variable quantities. Through its constant use and numerous applications we become conversant with its power of analysis, oftentimes enabling us to determine the law between the quantities so plotted, and thence to anticipate results in the performance of machinery. There is no reason why the same method may not be applied to the data of an industrial establishment and with as much value to the user. The manager or superintendent should know for each day, week or month the exact details of each department under him, and have these records available for future reference. The readiest way will be to plot a curve of such data from day to day, for a week or for a month. A series of such curves carefully drawn will enable him to determine certainly and at a glance the situation for each day, the amount of progress made on any given piece of work, and the cost of the same, as well as the daily expense account.

When the engineer wishes to ascertain what the cost will be of a certain project, what his machines and men are capable of doing in the line of work proposed, he resorts to a set of thorough tests, such as will supply the needed information upon which to base the future work. In this respect he is quite likely to have the advantage over his competitor in knowing, from the result of his tests, precisely what is the next best thing to do, what further investigations are required to be made and when and in what direction. How many business men to-day, who have not had an engineering education, would listen to one who should thus ascertain and inform the manager of his works that the furnaces were consuming twice as much coal as need be, and further suggest that continued records, under known running conditions, would show just where the coal bill might be reduced?

In another instance the manager walks through the establishment inspecting the progress of the work and noting the operation of the machines. "They are cutting," it is true, he will hear. But, are they cutting all that they should under the circumstances? If not, why? Does the foreman permit the waste of time and

power? If so, why? If the foreman does not know, or does not care, it is time to change to a new foreman in that concern.

From the day the student enters the institution to the day when he takes his degree certified by a diploma, he has been obliged to keep note books. The value of these will vary in direct proportion to the style and manner in which they have been kept as well as in their accuracy. If properly arranged and indexed he will find many useful items in them for future reference. These may save him, later, hours of valuable time and laborious search for information. They may, perhaps, save him many dollars. In one respect, at least, he has learned how to collect and preserve data and information upon which he may rely. It is some such work as this which must be done by the executive in any large establishment, only to a much greater extent. The manager's note book covers a different field, perhaps assumes various forms, as card indexes, scrap books, filing cases, sketches and drawings. If any one or all of these are kept in the way in which he should have learned to keep his engineering records, they will certainly save him much time, worry and anxiety at some critical moment.

One of the most important features attending the industrial development today is the free interchange of information. In this the engineer may well take pride, for he is preeminently the leader in such professional cooperation. The various technical and engineering societies have proved themselves of incalculable value to the business interests of the country. In their meetings there are freely discussed, even between the representatives of competing companies, the causes which make for gain or loss in works management, the most satisfactory methods of performing operations, and the best principles and theories upon which to conduct the business. In fact, papers and discussions are now presented before these societies eliciting and developing many points which a few years ago each establishment would have guarded with jealous care as a part of its own particular business and which was not its concern to make known to the public. The time has come to recognize that it is of mutual advantage to all parties interested, the manufacturer as well as the purchaser, to exchange ideas and opinions, records and methods. Even between neighboring firms and competitive producers of the same commodity, we find such interchange of views and discussions welcomed. They lead to better ways of taking care of the troublesome details with which each concern knows the other is hampered.

The engineer who has had the education and experience of which we have spoken, knows where to place apparatus, tools and the machinery for the generation and transmission of power. In general, all of his equipment will be so located as to be most serviceable and efficient. The same training in ability and capacity enables him to place likewise his men to the best advantage. Throughout the works, as planned, materials and labor will then move along with the least amount of friction and delay.

The men whom the executive engineer manages are working as cooperating, and yet in a sense as competing units. The process of shifting men, nevertheless, continually goes on. It is oftentimes made without reason, in the opinion of those who are not given larger opportunities or larger pay. The works manager, however, is always frank and courteous. The employés over whom he is in temporary control are men like himself. Their mutual interest is aroused as the work progresses and some measure of its efficiency begins to be apparent to their credit. In such management, when it is most successful, there is always exercised sound common sense. If his men do not stand the test nor increase the efficiency of their machines and work as well as the efficiency of themselves, the manager must needs secure those who will. This it is his duty to do, in order to add to the success of the company, and the worth and advancement of its undertakings. In the long run, these essentials are not to be considered as separate and distinct from the welfare and interests of the men who make the establishment.

The manufacturing industries are every day opening up larger opportunities and more responsible positions for the trained and competent engineer. His work is sensibly appreciated and felt, as time moves on, to be more and more in closest relation to the public good. It is a very serious question whether, without the engineer, we should now be enjoying the conveniences of travel and transportation, the transmission of intelligence, healthful homes with agreeable surroundings and public sanitary conditions, as well as the material prosperity that follows the development of our natural resources. Today, we find the engineer in almost all of the various types of industrial establishments, wherever, in fact, raw material is to be manufactured into a finished and marketable product, as in the textile and other industries for the manufacture of cloth, fabrics and articles of wearing apparel; and in the manufacture of food stuffs and provisions. He is steadily at work developing the timber and mineral resources of the country, improving its rivers, harbors and irrigation. He is building up the material structure of the modern city, its parks and boulevards, its water supplies and drainage, its lighting, transportation and fire protection systems. Through the refinement of the instruments of precision which he has made, he has brought the stellar universe within reasonable distance for mapping its systems and investigating its elements, enabling man to arrive at a truer and nobler conception of his own place in that universe.

Many are saying, as of the older professions, that that of engineering is becoming crowded, notwithstanding the fact that every day witnesses an enlarging field for its work. New materials, processes and methods demand new men. There is scarcely an article of useful manufacture which does not have its origin and development in such relation to the engineer's work that without him it would not have been or it would cease to be. He is ever moulding and shaping things to useful purposes. In view of this fact it does not seem plausible to say that the young men of to-day will not find the opportunities awaiting them which the past generation enjoyed. They may not find the same opportunities; but it is the privilege of the engineer to make opportunities. The supply of educated and trained engineers, of competent thinking men, capable of forming the strong advance guard of the profession, is not yet nor is it ever likely to be equal to the demand. Those who enter this field with the determination to succeed can not be disappointed unless that determination is allowed to sag.

"The almost invariable consequences of engineering training—thoroughness, command of details, observation and the comparing of observations, appreciation of the value of continuous records, courage and ability to grapple with new conditions, faculty of organization, the concept of the fundamental importance of efficiency—these are more and more demanded of the manager of the great undertakings which characterize modern material civilization."

Review of the Telegraph and Telephone Industries.

The address of Mr. John Gavey, delivered when he entered into office as president of the Institution of Electrical Engineers, of Great Britain, gave a review of the telegraph and telephone industries. The following is an abstract of Mr. Gavey's paper:

The art of telegraphy, considered in its broadest sense, as a means of conveying intelligence over distances beyond the reach of the human voice, may be classed under three different heads:

First—The communication of a limited number of definite orders or items of interest by certain prearranged arbitrary signals. Under this heading may be included railway signaling and lighthouse signals, fire-alarms and other kindred uses.

Second—Communication of all classes of information by means of alphabets, either arbitrary or those in common use, including semaphore and flag signaling, Morse and other signals, printing and writing telegraphs.

Third—Communication by actual exchange of speech by the telephone.

Under the heading of telegraphs for special requirements come the systems of railway signals so largely used. The range over which a mechanical semaphore may be worked is about 1,000 yards as a maximum, and the introduction of electricity for the work of telegraphs was soon followed by the invention of electrical miniature signals or indicators placed in railway cabins, from which the outdoor manual signals were worked in accord with the indications recorded electrically. By this means the range of signals was extended so as to cover the whole length of the section, and this led to the practical introduction of the block signal of working traffic. Successive improvements in the electrical apparatus have been introduced. For example, on single lines this apparatus is now associated with the train staff or tablet system. Repeaters of various types, which show the position of switches, the indication of signals, the presence or absence of trains in defined localities, and other information, keep the signal man advised of all the facts with which he should be acquainted. It is not too much to say that the safety and regularity with which the heavy railway traffic is conducted is largely due to the work of the electrical engineer. Lately, definite advances have been made in two directions in this field of applied electricity. In the first, complete electrical systems of operating switches and signals have been introduced, the apparatus providing interlocking gear and indicators which give the signal man positive information as to the position of every switch and signal. The work is easy, rapid and apparently reliable, in so far that every eventuality and cause of trouble appears to have been foreseen and provided against. This method admits of working signals and switches at distances far in excess of the manual system, such distances, in fact, only being limited by considerations of safety or convenience.

In another direction, automatic methods have been designed for working outdoor signals directly by the action of the train itself. Its entering, continuance in, and exit from a station are faithfully followed by the movements of the semaphores. It is not too much to say that without the various methods of electrical control which have been devised, and which are in general use, it would be utterly impossible for great railways to carry one-half the traffic they are now dealing with daily with safety and despatch. In this branch of electrical work daily progress is being made, and apart from the question of haulage, the extension of the methods of electrical control will probably be considerable in the immediate future.

Fire-alarm signals have in the past few years assumed a position of considerable importance, owing to the growth of great cities, the increasing height of commercial buildings and the large quantities of combustible material necessarily stored in the great centres of population. Starting from a simple alarm, which is merely the old fire-bell worked electrically, complete systems of fire-alarms and indicators have been devised, which, when actuated from any given point, give the appropriate signals to the fire-stations concerned. For the purpose of transmitting defined, but limited, items of information, for making demands, for special instructions, innumerable electrical appliances have been devised, but there is a general tendency to replace such apparatus by telephones, which simply extend the range of the natural method of communication to any distance, and which render these subsidiary aids unnecessary.

The great railway companies have availed themselves of the resources of the telegraph for the regulation and safeguarding of their traffic. This is indicated by statistics, which show that since 1879 the number of miles of railway telegraphs in Great Britain has been trebled.

The following figures were given as being approximately accurate statistics for the use of the telegraph and telephone for the entire world. They refer to the year 1902. There were then in use 3,433,911 miles of aerial telegraphs; 225,748 miles of underground telegraphs, making a total of 3,659,659 miles. There were in use 265,835 telegraph instruments. The telephone companies in the same year had in use 4,197,416 miles of overhead wire; 2,530,215 miles of wire underground and 11,145 miles of submarine wire, making a total of 7,467,417. There were in use 3,534,036 telephone stations.

The growth from the year for which the figures are quoted has shown no signs of diminution, and it is difficult for even those best acquainted with the situation to forecast the ultimate development.

Statistics were not available showing the amount of capital expended on telegraphs and telephones, but it certainly amounts to hundreds of millions of pounds sterling. Consideration of the figures which were available shows that neither of these two industries gives signs of lagging behind the other branches of electrical engineering, and so far as the telephone is concerned, it is thought that its commencement has only just begun in the United Kingdom. Much of its future success will depend upon the action of the local authorities. At the present there is a tendency for them to lay unnecessarily severe restrictions, and in this way greatly hinder telephone development.

It is interesting to note how the practice in the ordinary telegraph service has been materially benefited by the development of other branches of applied electricity. Thus, for testing and localizing faults, and in order to obtain control over a large mass of wires entering the principal offices in England, these were formerly attached to screw terminals fixed in a test-box, which was bulky and which occupied much valuable space in a costly building. Practice in the post office now is to terminate these wires in telephone jacks, and to provide for connections for testing, crossing or other purposes by means of plugs and flexible cords, the modern arrangement only occupying one-third the space of the old type. Further, the extended introduction of secondary cells, charged by means of motor-generators from the lighting circuit, has resulted in abolishing about 150,000 primary cells used in the post office until recent years. Another interesting change has been the fitting up of the central office in London with a switchboard for connecting through the outlying offices. Until recently these offices were forced to transmit their messages to the central office, where they

were repeated through to their destinations. To avoid this repetition, a special switching board, based on telephone lines, was designed to meet telegraphic requirements. Now any office connected to the switch which wants to communicate with another similarly connected, simply calls the latter. The switch clerk, hearing the call, merely joins the two lines through in the manner adopted for telephonic service. Suitable signals are provided to indicate when lines are engaged. This switchboard has done away with the repetition of some 18,000 messages daily.

Extensions of submarine telegraphy have grown in proportion with the other telegraphic work during the past half century. In 1902 it is estimated that the total number of nautical miles of submarine lines was 212,894.

Types of submarine cable have not changed materially, with the exception of the air-spaced cable now employed for telephone purposes. The longest telephone cable of the old Paris type was laid by the British post office in the year 1902, for communication between London and Brussels. It is forty-seven knots in length—about the practical limit of distance over which satisfactory telephonic speech is possible under existing conditions, when allowance is made for the addition of the connecting land lines.

Wireless telegraphy was taken up under five heads: first, leakage across the earth or water between two parallel lines erected on opposite sides of the position which is to be bridged; second, electromagnetic induction between coils placed vertically or horizontally; third, a combination of the two above systems by the erection of two parallel overhead wires connected to earth at their extremities; fourth, the electrostatic effects of vertical conductors; fifth, the Hertzian system. Attempts to apply the first method have met with varying success, but it has only a limited scope. The second method has a limited range. It has only been rendered possible by the use of telephone instruments, because of the small amount of energy transmitted. The third method was fully investigated by the British post office prior to the invention of the Hertzian method. There are two installations of this type still at work in England. One of them connects Rathlin island with the mainland at Ballycastle, the parallel wires being at an average distance of eight miles apart. The second is an installation establishing connection between the Skerries, a series of rocky islands off the coast of Holyhead, with the telegraphic service on Holyhead island itself. The parallel wires are at an average distance of three miles apart. The latter installation is worked telephonically. Speech is actually transmitted from wire to wire. The fourth system of communication is by purely electrostatic effects, and has not been developed on a practical scale. The fifth or Hertzian system has created world-wide interest, and its development in the course of the last few years has been very marked. The first development was termed the "whip-crack" method—that is to say, a powerful spark coil was connected, one terminal to the vertical conductor, and the other to the earth. In present methods this system has been modified, as the advantages of having a tuned circuit, which will vibrate for a longer time, are recognized. In this way a train of waves is generated which lasts for a considerably longer time, although the amplitude of the first wave is much less than that in the whip-crack method. Much of the troubles of the earlier workers was due to the sensitiveness of the coherers, which failed to decohere.

The receiving apparatus has undergone many modifications since the original filings coherer was invented. There are now a number of ways of constructing devices sensitive to electric waves. All of them are, however, dependent for their action on imperfect contacts.

As to the possibilities of wireless telegraphy, it is thought that it will not, under any circumstances, supplant or even compete seriously with inland methods of communication. There is, however, a very distinct and important sphere of utility awaiting its development. For communication between ship and shore, and ship and ship, much has been done, and much yet remains to be done. For intercommunication between neighboring coasts there is also a possible future. This depends almost wholly on the further development of the methods of syntony or tuning. There appears to be no doubt that in cases in which the wave-lengths used on two systems differ to a considerable extent, a very marked degree of success has been obtained in the avoidance of mutual interference. It is thought that tuning methods will be still further improved. The progress which has been made since the year 1896, when it took a week to receive a few elementary signals over a distance of nine miles, up to the present time, when such remarkable results have actually been obtained, is so great that it does not imply the possession of an unusually sanguine disposition if one ventures to predict further improvements which may be expected to increase the freedom from actual interference, the speed, and the reliability of this method of communication. But it does not appear to be very probable that it will seriously compete with the highly developed cable communication in the near future, although it may, in many instances, supplement that service.

In telegraph construction methods, one of the noteworthy changes has been in the substitution of hard-drawn copper for iron wire. This gets rid of the magnetic inertia of the iron wire; and while copper is itself more expensive, it has a value as scrap. Moreover, when the time arrives for converting overhead telegraph circuits to telephone uses, appropriate conductors will at once be available.

In underground telegraphs something approaching a revolution is in progress. It is a curious fact that the majority of the early inventors who designed or imagined methods of telegraphy contemplated the use of underground wires insulated by various ingenious methods, which, however, would scarcely have proved efficacious in practice. Various reasons led to the abandonment of underground work in favor of overhead lines, and little was done in later years in the direction of providing a comprehensive underground system until the great work in Germany was initiated in the seventies. Owing to the high cost of gutta percha, and to its great specific inductive capacity, the extended use of this material did not commend itself in England, except in large towns where underground work was imperative. The introduction of the modern multiple cable, insulated by dry paper and enclosed in a lead sheath, has gone a long way in the direction of overcoming the objections of great cost and high static capacity.

Not the least important of modern developments of electrical engineering is the extraordinary growth of the telephone service throughout the entire world. Subsequent to the year 1860, when Reis invented his musical telephone, it was thought by many that no further approach toward the attainment of articulate speech could be made. The possibilities attending the use of loose contacts—at that time the most dreaded enemy of the electrical engineer—had not been foreseen, and the conclusion was generally arrived at that it would be impossible to devise a transmitter free from the defect of causing actual breaks in continuity, so as to admit of the delicate curves necessary for the transmission of articulate speech. The work of Bell and others, and the development of the modern paper-

insulated cable, led to the general adoption of the one main factor in satisfactory telephone work—the use of well-insulated metallic circuits constructed so as to be free from cross-talk. This opened the door to the use of the very best types of telephone transmitter, and paved the way for the successive improvements in exchange plant that are so marked a feature in modern systems, and have led to the extraordinary increase in telephone statistics that has taken place in the last ten years.

As a result of successive inventions and study, a rapid improvement in the indoor plant available for exchange work has taken place, and so far as the modern telephone switch is concerned, these improvements have been wholly in the direction of reducing the amount of talk on the part of the operator that was necessary under the old conditions. This has been brought about by the provision of a complete system of automatic signaling. This tendency to reduce the operator to a species of intelligent automaton naturally suggests the possibility of the entire elimination of the operator and the introduction of suitable automatic apparatus at the exchange. Several very ingenious methods of attaining this end have been devised. Several exchanges of some magnitude have been fitted with automatic apparatus in America, and two or three small automatic switches have been installed in Europe, but no European administration has yet faced the problem of establishing an extensive automatic system for the use of towns in which large exchanges are required. The subject is, however, being carefully studied, and there appears to be some possibility of development in the not distant future that may lead to important modifications in present methods.

The determination of the distance over which telephonic speech is possible in various types of telephone circuit is a question of the greatest theoretical and practical interest. It is one that has received much careful consideration. The theoretical investigations of Clerk Maxwell, Kelvin, Heaviside, Campbell, Pupin and others have done much to elucidate the problem under consideration, and we are now fairly well acquainted with the various factors that govern and limit the range of possible speech, and the methods by which these limits can, under favorable conditions, be extended; such, for example, as the partial neutralization of the effects of static capacity by the addition of self-induction. As the preliminary to the determination of the limits of speech, it is necessary to ascertain the degree of volume and articulation; or, in other words, the conditions which may be accepted as satisfactory; and, further, to establish standard circuits with well-known constants of resistance, inductance and capacity, to which all lines may be reduced, either by calculation, by experiment, or, preferably, by both. For this purpose, both in America and England, one of the types of ordinary lead-covered, paper-insulated cables in which the above constants are measurable has been selected. In considering this question from the practical point of view, it is necessary to take into account the variable conditions under which long-distance speech is frequently held. The insulation of long overhead wires may, in the climate of England, drop in extreme cases to a figure as low as the metallic resistance of the conductors themselves. Slight inductive noises are never really absent, and occasionally they preponderate. It is difficult to obtain even an approximately perfect static balance between a telephone circuit and the neighboring wires subject to rapidly varying potentials. Again, the human element largely affects the result. It may be said that the limits of error in calculation, whether the empirical or more accurate formulæ are used, are less than the limits of variation in practice, and that there must always be a considerable factor of safety to ensure satisfactory intercommunication. Telephone administrations have carefully considered what are the extreme limits of effective commercial speech. It is generally considered that from forty-two to forty-six miles of the above-named standard cable is the effective commercial limit, although conversations have been held by experts over sixty miles of such cable.

There are two methods of determining the limits of speed over various types of telephone circuits. The first is the application of Pupin's formula; and the second is a direct comparison of all existing types of line with the standard cable. The British post office has conducted a lengthy series of experiments to enable it to rate its cables, and has also been investigating the problem of telephonic transmission by means of the Duddell oscillograph. This instrument was employed for observing simultaneously the curves due to the action of the induction coil at the transmitting end, and the corresponding curves at the receiving end of the circuit. A number of letters, both vowels and consonants, have been rapidly spoken into the transmitter, and the respective transmitted and received curves for each have been recorded in the usual manner. The curves obtained show that over short distances there is no appreciable change in their shape, but when longer lengths of cable are introduced, the difference of amplitude is most marked, although the shapes of the two curves bear a substantial resemblance. Curves plotted from readings taken on the post office cables show that on short lengths self-induction predominates largely over the capacity. As the length of the circuit increases, the curve first rises, but as the capacity effects increase more rapidly than the inductances, the curve reverses and falls.

The post office has taken up the addition of self-induction to telephone lines to neutralize the capacity. In one case a cable containing fifty-six 100-pound conductors was loaded by the insertion of coils at intervals of a mile. The original factors were seventeen ohms resistance, 0.053 microfarad, 1.4 henries. The added inductance brought the total up to forty mil henries, the resistance being increased to 23.34 ohms. The equivalent range of speech was, however, increased from 66 to 176 miles. Very satisfactory results have been obtained in America and in Germany by the use of ring coils of extremely fine iron wire cores. The coils used at the post office contained no iron in any part. Experiments with overhead conductors proved not as satisfactory as with underground cables. The variation in the insulation of the open wires upsets the balancing due to the coils, and lightning troubles have affected coils. For the present, at all events, this method of increasing the range of open conductors of limited gauge can not be considered so satisfactory as the corresponding results with underground work; and opinions as to the future of open wire loading appear to be somewhat divergent.

Among the unsolved problems touched upon were the need for a more perfect receiver for wireless telegraphy, the production of a satisfactory telephone relay, the finding of a substitute for gutta-percha, to be used in submarine cables, and the further development of the modern telephone switchboard.

Electric Tramways Needed.

United States Consul Culver, of London, Ontario, reports that there is a good field in his district for the sale of materials for electric tramways. This part of the Dominion is thickly populated, and there are many towns and villages. At the present time there is but one road completed, which is some twelve miles in length, between the towns of Woodstock and Ingersoll. There is a line thirty miles in length, under construction from London to Port Stanley, but no other line is as yet projected. London is the industrial centre of this thriving district, which extends from sixty to one hundred miles in every direction.

New York Electrical Society.

The 254th meeting of the New York Electrical Society was held at 19 West Forty-fourth street, Wednesday, November 22, 1905. A most interesting lecture was given by Mr. O. S. Lyford, Jr., electrical engineer of Westinghouse, Church, Kerr & Company, on "The Electrification of the Long Island Railroad." Mr. Lyford said in part:

"All the great railway systems centering in New York are becoming electrified. The first system to show definite results is that of the Long Island Railroad Company, whose work is an admirable exemplification of all the latest developments in electrical train operation, current distribution and third-rail methods." Mr. Lyford, who has been actively connected with this important work, after detailing some of the special conditions which had to be met in the construction of the road, emphasized the following requirements:

"Public safety, safety of employés, continuity of service, prompt action in emergencies, permanence, economy of operation and highest class of construction." Such an undertaking in fact calls for the latest and best engineering practice in every detail and utmost diligence in construction. The requirements are not new, but a project of this character presents them with unusual emphasis. Likewise the solutions adopted are not radically different from the best that have preceded, but they are more perfectly worked out and better harmonized than ever before.

The pictures shown illustrated the fact that there is uniformity in the engineering and every detail is substantial, rugged and permanent in character. The equipment and structure are fireproof to an unusual degree. The buildings and cars and their equipment, and to a large extent the transmission system, contain no combustible material except that necessary for insulation purposes. As far as possible the same general factor of safety has been applied throughout.

The initial plant contemplated the electrification of about 200 miles of single track, of which 100 miles have now been equipped and are in operation. An equipment of 400 cars was contemplated and of this number 219 are completed.

The interchange of traffic with the Brooklyn Rapid Transit and possibilities of further interchange of traffic with other roads had much to do with the selection of the electrical characteristics of equipment. Direct-current, 650-volt motors are used and the power is generated and transmitted at 12,000 volts, three-phase, and distributed from rotary converter substations by means of third rail. The location of power station is at Long Island City and the adoption of this site made it practicable to consolidate at this point the equipment for supplying power to the Pennsylvania Railroad tunnels and to the Long Island Railroad system. The transmission system from power station to substations is partly overhead and partly underground. Steel motor-cars are used and the electropneumatic system of multiple-unit control.

The substations are simple in design and very permanent in character. These substations are located at the junction points. At Hammels the substation installation includes a 3,200-ampere storage battery. This is one of the first installations where the type R plate of the Electric Storage Battery Company has been used. One of the most interesting features of the substation equipment is the portable substation unit provided for handling the temporary loads at race-tracks and for relay purposes at the substations.

The underground conduit construction for transmission cables on a railroad right of way meets with many unusual obstructions. For the principal sections of overhead feeder lines steel towers are used.

Referring to the power station attention was called to the fact that this is the first large plant which is entirely dependent on steam turbines. Three 5,500-kilowatt units are in service. The most striking feature of the electrical installation in the power station is the arrangement of switching galleries which are entirely isolated from the engine room except that the operating gallery has a balcony which extends into the engine room. This balcony is provided with windows from which the engine room can be viewed. The operating room is well lighted, cool in summer and warm in winter, absolutely quiet, perfectly safe at all times, as it contains none of the high-tension conductors, and there is no possibility of steam escaping into it.

The following new members were elected: W. H. Warren, Albert Roe, Bernhard Hoffman, Charles Rogalsky, Walter Neumuller, E. A. Skehan, Albert Baldwin Hoffman, B. P. Wiltberger, Robert A. Broadfoot, Arthur J. Arwine, Felix Preston, Frank Davidson.

The First Train Despatcher.

Mr. A. H. Copeland, who for nearly thirty years, was agent for the Chicago & Alton Railway at Chenoa, Ill., claims to be the first man who ever despatched a train by telegraphic train orders. When the event took place in the early fifties Mr. Copeland little dreamed of the far-reaching result of a simple act of kindness.

It came about in this way: In the winter of 1852 Mr. Copeland worked in the post office at Middlebury, Vt., and was also telegraph operator, the telegraph offices in those days being generally located in the post offices and not in depots. Railways had no telegraph service of their own; the trains were operated wholly by time-card rules which provided that one train would wait at a certain station until the other train had passed. If one train was late at the meeting point the other was required to wait until the other showed up. Such a condition existed on the winter morning in February, 1852, when the first telegraphic train order flashed over the wires. The north-bound train, due to meet the south-bound train at Middlebury, was in a snowbank in the Green mountains south of Rutland. The conductor of the south-bound train was of course unaware of this, and o knew that he and his passengers had before them a wait at Middlebury anywhere from twelve minutes to twelve hours, when at the expiration of the latter time his train regained its right to proceed south to Rutland. As the length of delay increased, the restless, irritated passengers grew bold and wandered uptown from the depot. Some of them straggled into the post office and happened to tell Copeland of the delay. The operator thought a moment. Then he said: "You bring the conductor up here and perhaps we can fix it so that you can go on to Rutland without waiting for the north-bound train." The conductor demurred but finally acceded to the demand of his irate passengers. Upon arrival at the post office Mr. Copeland handed him a message from his superintendent at Rutland. It read something like this: "North-bound train in snowbank south of here. You come on down to Rutland and I will not let any train go north until you arrive." Mr. Conductor read his order, looked Copeland straight in the eye and said, "I am afraid to do this. I might be taking a chance. How do I know its genuine?" Copeland quietly replied, "I'll ride on the engine to Rutland." That settled it and the train went on its way, the passengers rejoicing and heartily thanking the operator, who kept up a wonderful amount of thinking while quietly sitting in the cab from Middlebury to Rutland.

It was not until 1868, years after all this, that Copeland went to the Chicago & Alton, where he found in full effect the perfected result of his original and accidental use of the telegraph in the movement of railway trains.

Electrical Notes from Europe.

By Our Special Correspondent.

THE new steam turbine group which the Brown-Boveri Company has installed in a large brewing and ice-making establishment at Rotterdam presents a special interest on account of the use of the exhaust steam of the turbine for various purposes. The establishment already had running a 700-horse-power horizontal engine coupled to a direct-current dynamo of 130 kilowatts. The engine also served to operate the ice machines and other apparatus. As the engine ran at times at light loads, it was decided to install a second group of smaller capacity to act as a reserve. The new group consists of a Brown-Boveri-Parsons turbine, coupled direct to a 130-kilowatt generator, and takes up but a small space. One of the main advantages of the turbine is that its exhaust steam contains no traces of oil and can, therefore, be used to heat the water which is needed in the establishment. A large amount of hot water is used for cleaning the barrels and for like purposes. It is furnished from a tank which is placed in the top story. Formerly the water was heated by live steam coming direct from the boilers at ninety degrees centigrade, but this method is very wasteful, owing to the great consumption of steam. Here the steam is injected directly into the water. Exhaust steam could not be used except by employing a complicated device for preventing the steam from coming in contact with the water, seeing that the exhaust steam from an ordinary engine contains traces of oil which unfits it for injecting directly into the water. Such a system would be too expensive and would have a low efficiency. The steam turbine and dynamo group, besides the other well-known advantages which it possesses, thus has another advantage which should be recognized, as it may prove useful in many cases. In the Oranjeboom establishment the exhaust steam is led up to the top story and runs into a set of special nozzles contained in the water-tank, arranged so that the water is set constantly in movement. Thus the water is heated much more economically than before, and the saving in coal over the other method is considerable. The new Brown-Boveri group, while installed as a reserve, is now considered as the principal machine of the establishment, and is set in operation whenever there is need for a supply of hot water. The turbine works with superheated steam at 250 degrees centigrade and makes 3,000 revolutions per minute. The dynamo furnishes 130 kilowatts at 115 to 120 volts.

The municipality of Cologne has recently had built a special form of motor street sprinkler for use upon the tracks of the overhead trolley road. It consists of a large cylindrical tank mounted upon a car-truck, and provided with a trolley. At each side and in the rear are the sprinkling nozzles for watering the street. The main platform which holds the tank is mounted upon two bogies of two axles each, and upon each of the bogies is placed a thirty-five-horse-power motor. The total weight of the sprinkling car is about twenty-five tons when fully charged. The width of the jet can be regulated at will, and at the full pressure the total width which is watered is about fifty feet. The capacity of the water-tank is about ten cubic metres, and it is filled in ten minutes. This amount of water, allowing the car to travel at the rate of twelve kilometres an hour, is sufficient to cover a width of eight to fourteen metres on a length of five kilometres. The motor system is in the line of modern progress and there is no doubt that machines of this type will come into use generally. In Paris an automobile street-sprinkler arranged on similar lines, but using a De Dion gasoline motor, is now running very successfully upon some of the large avenues.

A hydroelectric plant has been lately installed by the gas company of Clermont-Ferrand, a town of considerable size in the region of Lyons. The company already operates an electric station in the city using monophase current at 2,000 volts and forty-two cycles. An increase has been needed for some time, and it was accordingly decided to make use of a hydraulic plant at some distance from the city which could also serve for the surrounding region, besides the two localities of Clermont and Royat. The Sioule river furnishes the power and the hydraulic work has been carried out at a point near Queuille, lying at a distance of twenty miles from Clermont. This stream gives a good supply of water, but is subject to freshets at frequent intervals. In summer the supply is 4,500 cubic metres per minute, but in periods of high water as much as 40,000 cubic metres are noted. The dam is erected across the narrow valley containing the stream, and forms a basin 7.5 kilometres long and 150 metres average width. This gives a sufficient reserve against the low-water periods. The French Westinghouse Electric Company was charged with the electric outfit of the Clermont-Ferrand plant as well as the turbines. The hydraulic station is placed directly below the dam, and, contrary to the usual case, there is no intake canal, but the penstocks are run directly from the dam to the wheels.

The dynamo room is laid out for six groups of 1,200 horse-power each, using one group as a reserve. At present there are three units installed. The turbines on the Francis (Swiss) system were built at the Westinghouse company's works at Havre, as well as the alternators, exciters and apparatus, under the direction of Mr. Albert Schmid. The alternators are direct coupled to the wheel by electric insulating discs on the Zodel system. These machines furnish 1,000 kilowatts on the three-phase system, operating at 1,000 volts. Their speed is 333 revolutions per minute, and they give fifty cycles. An alternator of the inductor pattern is used in this case. The exciting current is furnished from these generators, each driven by a smaller turbine of seventy-six horse-power. In both cases the turbines work under a head of water from twenty-one to twenty-five metres. Step-up transformers raise the current to 20,000 volts for the lines which run to Clermont-Ferrand and other localities. The principal substation is located at Clermont-Ferrand. It contains three groups of three 375-kilowatt transformers each, which lower the tension to 3,000 volts.

An extensive cable transport system for handling coal and iron ore on a large scale is in use at present at the blast furnaces which are located at Portoferraio, on the island of Elba. The cable conveyer is one of the largest in Europe. It serves in connection with a set of large cranes to unload the material from the boats in the harbor at 220 metres from the shore, and to transport it to the storage deposits placed at sixty-five and 200 metres inland for the coal and the ore respectively. The material is handled at the rate of 100 tons an hour. The apparatus which is used for unloading the ore from the boats consists of eight cranes of large capacity, four for the ore and four for the coal. The cranes are

placed upon a platform built upon piles. Two electric motors are used for operating the cranes. The motors have a capacity of fifty horse-power each, and one motor works four of the cranes, having four hoisting-drums connected with it. After unloading, the material is charged upon a series of buckets which hang from an overhead cable line and are drawn along upon it by a traction cable. The car runs thus up the ascending way, drops its load and returns by the descending cable. Two cable-drums are provided for the conveyer system. There are two parallel sets of conveyers, one for the coal and a second for the ore. Each car or bucket receives a load of one ton of material, and the cars run at intervals of thirty-six seconds, at a speed of thirty inches per second, and are spaced at eighty feet apart. The motor which operates the cable-drums is of the fifty-horse-power type. The new electric system is found to be of great value in the rapid and automatic handling of the material. A German firm, Bleichert & Company, of Leipzig, furnished the electrical outfit for this plant.

The towns of Evian and Thonon, both of them well known among the watering-places of Switzerland, and located on the south bank of lake Leman, at the foot of the Chablais mountains, decided to erect a hydraulic plant in the neighborhood in order to secure a supply of current for the local lighting. The torrent of the Dranse was found to be available in this case, and the hydraulic plant was erected at Chevenoz, a point about fourteen kilometres from Thonon, and twenty-two kilometres from Evian. The electrical work of this plant has been carried out by the Oerlikon Company. From the dam which has been placed across the stream, an intake canal, which is open for the most part, runs along the side of the mountain for a length of 800 metres. The canal leads to the main basin, from which a penstock, one metre in diameter and 250 metres long, runs down to the hydraulic station. The head of water is fifty-five metres and the flow two cubic metres per second, which corresponds to 1,100 horse-power available. The Checenoz station contains turbine and dynamo sets, which use Piccard and Pictet wheels of the well-known Swiss make. The wheels give 350 horse-power each, and run at 430 revolutions per minute. The shaft is horizontal and on it is mounted the alternator of the Oerlikon make. These machines are three-phase alternators of the inductor type. At a speed of 430 revolutions, they will furnish a current of 5,200 volts (3,000 volts simple tension) and fifty cycles. Step-up transformers are not used here, but the current passes from the switchboard to the line at a tension of 5,200 volts. The overhead line which runs to Evian is made up of three four-millimetre wires, and a fourth wire which serves as a balancing line. The transformers at Evian are placed either in square kiosks or in the buildings. They lower the tension to 120 volts for the secondary mains, and are used in sizes varying from thirty kilowatts down. At Thonon, which receives a second high-tension line, a similar arrangement is used.

Among the new European electric railroads which are now in successful operation, we may mention the electric line which runs between Berthoud and Thun. It is one of the most important electric railroads in Switzerland, and is of special interest as an example of the three-phase system. The starting point of the line is the station of Berthoud, which is on the railroad line from Zurich to Geneva via Berne. The electric line uses part of the already existing Emmenthal railroad and then separates from it and passes through a mountainous region, crossing the Jura-Simplon railroad and reaching the terminal station at Thun, which lies on the main railroad from Berne to Interlaken. The electric line thus gives a communication by a direct route between the north and the east of Switzerland on the one hand, and the Bernese Oberland on the other. As it runs through a very picturesque country, it is largely utilized by tourists. The road has a total length of 40.2 kilometres, and is shorter than the railroad between the same points by 12.2 kilometres. It connects also at two intermediate points with the steam railroad lines, making four points in all. The three-phase system which is used here was installed by the Brown-Boveri Company. An overhead wire is employed, which is double, with a trolley on each wire, and a rail return. The tension between the wires is 750 volts. The cars had to be of some length. A motor-car holding sixty-six places and a trailer of seventy places are used here, having a total weight of twenty tons, and running at twenty-five miles an hour on grades of twenty-five per cent. By coupling two trains together it is possible to take 280 passengers at a time. The freight trains using electric locomotives run at ten miles an hour. The motor-cars and trailers are long, square-built cars of the ordinary pattern. Each motor-car carries two bogies and four sixty-horse-power motors. Current is supplied from a hydraulic station in the neighborhood.

C. L. DURAND.

Paris, November 25.

The Question of Temperature and Efficiency of Thermal Radiation.

At a recent meeting of the Physical Society, of London, a paper was read by Mr. James Swinburne, on "The Question of Temperature and Efficiency of Thermal Radiation."

It has long been known that various surfaces have different emissivities, and it is generally held that at a given temperature some bodies radiate a larger percentage of their total radiation in the form of light. This view is largely based on some experiments by Evans and Bottomley. Evans's experiments really show that if two filaments, A and B, of the same area, but of low and high emissivities respectively, are run to give the same light, the filament A of lower emissivity will give a higher efficiency, and it will give a still higher efficiency if run so as to use the same power as B. This is a natural consequence of the different emissivities, and does not at all show that A gives a higher efficiency at the same temperature as B. Professor Bottomley's experiments are criticised on the ground that he used no photometer, and his reasoning attacked on the ground that he makes the same slip as Evans in confusing difference of emissivity with difference of efficiency at the same temperature. It is urged that a body A at the same temperature as B can not give out radiation corresponding to a higher temperature of B; for if it could, and A and B were enclosed in a perfectly reflecting space, A would heat B to a higher temperature than A. It may be said that A can have a higher efficiency than B, not by giving out rays corresponding to B at a higher temperature, but by omitting to give some of the longer radiations that B gives. If this were true, a hot body might be surrounded by a thin case of A lined inside with a substance which only emitted and absorbed long waves. The case would then take in long and give out short waves, though colder than the source. High efficiency or selective emissivity is always sought in polished, grey or white surfaces like flashed filaments, platinum and other metal wires and rare earths. If there were such a thing, it should be found not in white, but in black bodies, as a body which is a specially good radiator of light when hot should be black when cold. Lummer's curves of the distribution of energy for a "black body" and polished platinum are compared, and show somewhat higher efficiency for platinum; but the comparison is difficult. The behavior of flashed lamps and incandescent gas-mantles is explained by the difference of emissivity, without any need for selective emissivities.

Society of Naval Architects and Marine Engineers' Visit to Schenectady.

Following the final event of the general convention of the Society of Naval Architects and Marine Engineers, held in New York Thursday and Friday, November 16 and 17, invited guests to the number of 135 boarded a special train at the Grand Central station early Saturday morning for Schenectady, shortly after the closing banquet at Delmonico's. The banquet was very successful and a fitting climax to the preceding two days' business sessions.

Among other speakers at the banquet were General Eugene Griffin, first vice-president of the General Electric Company; Rear-Admiral Evans, United States navy; H. D. Goulder, head of the Merchant Marine League, Cleveland, Ohio; Senator Gallagher, of New Hampshire, and others.

The special train arrived in Schenectady Saturday morning, and was switched into the yards of the General Electric Company, where breakfast was served on the train. The visitors were then escorted in groups through the works in charge of representatives of the company. For the information of the visitors, a pamphlet was distributed, which illustrated the marine section of the company's products and works, including a diagram of the route of inspection. The morning was spent in inspecting the various shops, including those devoted to the manufacture and test of the Curtis steam turbines, which were of special interest to the visitors, as were the searchlight projectors and other applications of electricity to marine service.

Among the visitors were Mr. H. L. Aldrich and Mr. Herbert, of *Marine Engineering;* W. T. Berry and D. H. Gardner, of the New York, New Haven & Hartford Railroad, marine construction department; Professors E. H. Bull and A. J. McLain, of Webb's Academy; Mr. George L. Craig, president, Craig Shipbuilding Company, Cleveland, Ohio; D. E. Ford, engineer of floating equipment, Standard Oil Company; William Gardner, designer of the yacht Atlantic, winner of the transatlantic race for the Emperor William cup last summer; Mr. H. C. Higgins, Old Dominion Steamship Company; C. A. McAllister, chief engineer revenue cutter service; Mr. H. A. Magoon, chief engineer of the Maryland Steel Company; Admiral J. A. B. Smith, United States navy; C. P. Weatherbee, chief engineer of Bath Iron Works; Aaron Vanderbilt, engineer; A. J. Woodward, United States navy; J. R. Andrews, president, Hyde Windlass Company; Geo. A. White, Hudson River Day Line; J. A. Penton, Penton Publishing Company; Fred Shaw, *Shipping Illustrator;* A. E. Potter, Rudder Publishing Company; W. C. Wallace, Clyde Shipbuilding Company, Scotland, and others equally prominent.

The society members of the General Electric Company were in charge of the trip, and the entire matter was handled by Mr. J. W. Kellogg, head of the marine department of the company.

After the morning spent in the works, the train was again delivered to the New York Central, and the guests returned to New York city in the afternoon.

Zinc Fuses.

Some time since Messrs. Alfred Schwartz and W. H. N. James made a study of zinc and aluminum as materials for fusible cutouts. In a recent article they gave some further information regarding the use of zinc. This metal can not be drawn in a wire, and can only be rolled while hot; while aluminum wire of small diameter is unreliable as a fuse, since the coating of oxide holds up the molten metal. The two metals must therefore be used in strip form. With copper strip the fusing current is proportional to the breadth of the constant thickness, and the curves connecting these quantities all pass through the origin. If, however, the fusing current be plotted against the thickness for constant breadth, it will be found that the lines pass through a point on the axis of thickness considerably to the left of the origin, due to the increased carrying capacity per unit area in the small strips. In the case of lead strip, the curves connecting fusion current and breadth, when extended backward, are found to cut the axis of breadth at a point considerably to the left of the origin for a similar reason; while on plotting fusing current against thickness for a constant breadth, the curve is found to follow a logarithmic law. Since the melting point of zinc and its current density at fusion are intermediate between those of copper and lead, the law connecting its fusing current and dimensions may be regarded as being intermediate between those for lead and copper. The law may be expressed by the following formula: $C = k (b + b_1) (t + t_1)$, b_1 and t_1 being constants independent of the breadth and thickness of the fuse, and k a constant depending upon its length. In centimetre measure, b_1 is equal to 0.1, and t_1 to 0.01. This law will hold for thicknesses from one one-hundredth to one-tenth centimetre, and breadths of from four-tenths to one and one-half centimetres. The experimenters have not carried the research above 300 amperes, but believe it will hold for 400 or 500 amperes. Zinc fuses show very little deterioration, and may be run at ninety-five per cent of their normal fusing current. The metal does not become red hot just before fusing. It has been found that when a strip fuse is made narrower at its centre, that the arc which is formed is limited to this narrow portion, provided it be about one and one-half inches in length. This action assists much in suppressing the arc. Zinc is free from oxidation even at high current density. It therefore makes a desirable material for fuses. It should be borne in mind, however, that for a given fusing current a zinc fuse, measured in volume, it will be approximately 4.4 times that of the copper fuse. Another objection lies in the fact that the molten globules of zinc continue to burn in air. When used in enclosed forms, the cartridge should be larger than that required by a copper fuse.—*Electrician (London), November 17.*

A Standard Third Rail.

The New York Central & Hudson River Railroad Company has initiated a movement to induce all the railroads in the eastern part of the country—more especially those railroads entering New York and Jersey City—to decide upon a uniform type of third rail. While many of the railroads which have been asked to consider the matter have no immediate prospect of electrifying any part of their lines, it is believed that in the event of all of the eastern railroads using electricity, an agreement with regard to a standard form of third rail would be beneficial.

"McClure's for a Twelve-Month."

The S. S. McClure Company, New York city, has published a very neat booklet entitled "McClure's for a Twelve-Month." This gives a brief outline of the timely articles and clever stories which will appear in *McClure's Magazine* during the coming year. In addition to pure fiction, narrative and historical matter, there will appear a number of articles dealing with the technical features of various industries. Mr. Ray Stannard Baker will undertake a commercial discussion entitled "The Railroads and Their Owners."

The Alexandria-Ramleh Electric Railway.

By Enrico Bignami.

DOUBTLESS every tourist who visits Alexandria (Egypt) has made an excursion to Ramleh, the interesting section which extends for about ten kilometres to the east of the city from the Ibrahîmiye station to the terminus at St. Étienne. It consists of an uninterrupted series of splendid villas and magnificent gardens descending to the sea. It is here that the wealthy families of Alexandria and of Cairo reside when the heat of the summer renders unbearable further sojourn in these cities. It is here also that many business men have made their permanent homes, consisting, for the greater part, of Europeans who are obliged to go daily to Alexandria, but prefer villas scattered in the fresh green and hidden among stately palms, perpetually moved by the north sea breezes, to houses exposed to the noise and dust of the city. In this quarter, not far from the Ibrahîmiye station, are located the large hippodrome and the English athletic field, both of which are frequented largely, as well as the hotel casino of St. Étienne, the most popular resort of Alexandria, which is placed on

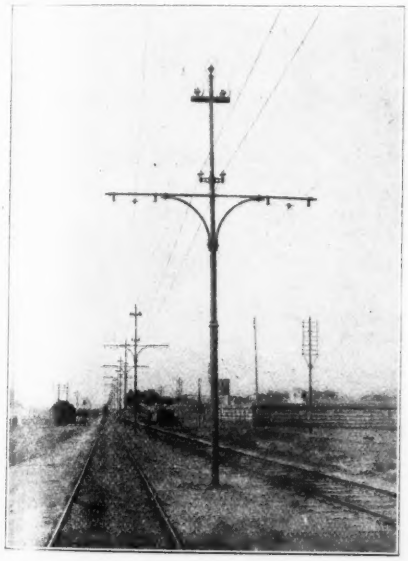


Fig. 2.—Alexandria-Ramleh Electric Railway.

the shore of the sea, and surrounded by orange groves and beautiful cultivated gardens. Here during the hot afternoons of the summer the residents of Alexandria resort by thousands to attend the concerts and entertainments given frequently, and to enjoy the baths which are fitted up luxuriously with all modern comforts.

Up to the year 1893 the heavy passenger traffic between Alexandria and Ramleh was made by steam on a single double-track line between Alexandria and Bulkeley. At the latter point it divided into two branches, each with a double track, which passed through the more important centres of the section, coming together again at St. Étienne. In order to serve the constant traffic it was found necessary to run the trains on this road during certain hours of the day on a fifteen-minute headway. The management of this Alexandria-Ramleh road, in view of the constantly increasing passenger traffic, determined to transform from steam to electricity, and placed the contract for the work with Brown-Boveri & Company, of Baden, Switzerland. This company has con-

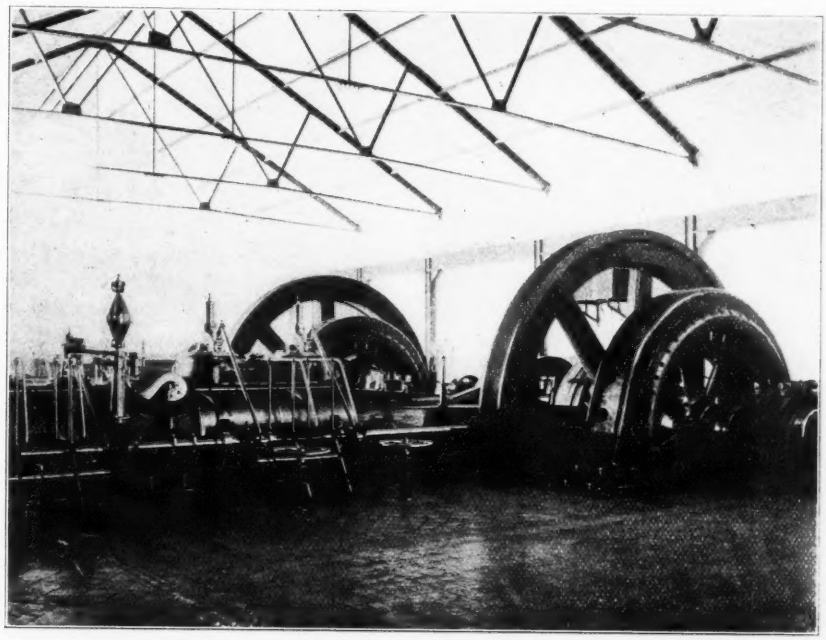


Fig. 1.—Two Generator Groups, Alexandria-Ramleh Electric Railway.

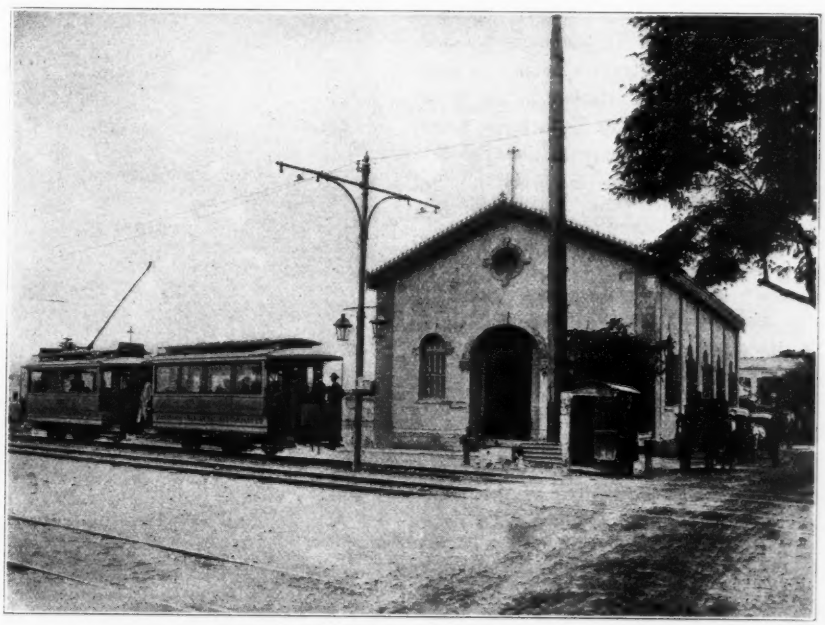


Fig. 3.—Transformer Substation at Bulkeley, Alexandria-Ramleh Electric Railway.

structed a system which generates directly three-phase current at 6,500 volts, by means of two three-phase alternators, each rated at 600 kilowatts, and having twenty-eight poles. These revolve at a speed of 170 revolutions per minute, giving a frequency of twenty-five cycles per second. The steam engines to which the alternators are directly coupled were furnished by the house of Franco Tosi, of Legnano, Italy. They are of the tandem-compound type, capable of developing normally 750 horse-power, and a maximum of 1,000 horse-power.

In Fig. 1 is shown a view of the two generator groups. The revolving magnetic fields of the alternators are not keyed directly to the engine shafts, but are attached to the flywheel of the latter by means of a flange.

There are also two continuous-current machines rated at thirty-five kilowatts at 100 volts, which are driven by means of belts from pulleys attached to the engine shaft. These furnish the exciting current. Each of these exciters is sufficient to furnish the exciting current for both alternators at the same time.

The distributing switchboard is of the usual Brown-Boveri type, and includes an exciter panel, two alternator panels, and two panels for the outgoing lines. All of the high-tension panels are provided with oil switches, and those for the outgoing lines are provided, in addition, with an automatic arrangement for opening the switches in case of abnormal overloads or short-circuits on the transmission line.

A high-tension transmission line connects the generating station to the transforming substation at Bulkeley. Starting from the generating station the line consists of a three-core cable about 6,300 metres in length. From the end of this cable on the line is carried overhead on the iron poles which are used for supporting the trolley wire brackets. A view of a stretch of the line is shown in Fig. 2. At the top of the pole may be seen the three high-tension wires mounted on double-bell insulators of American make. Below them, close to the cross-arms, are the feed wires for the trolley; and, finally, suspended over the centre of the track, are the two working trolleys. An interesting characteristic of the high-tension line is the guard wires attached to each insulator, as was prescribed by the Egyptian government. These serve to ground the line in case of the breaking of a wire.

The high-tension line terminates at the transforming station at Bulkeley, a distance of 10,500 metres. This substation is illustrated in Fig. 3. Here, from the high-tension collecting bars, the current is carried through three oil switches to three three-phase transformer groups, each group consisting of three single-phase transformers connected in delta. Each transformer is rated at 110 kilowatts, and reduces the voltage from 6,500 to 350.

The transformers are shown in Fig. 4. The high-tension tablets for the transformer primaries may be seen at the extreme left of the switchboard, which is shown in the view of the substation (Fig. 5).

The alternating current, at the reduced voltage of 350, is fed to three rotary converters, and transformed to direct current at 560 volts. Each of the converters is rated at 300 kilowatts, and operates at a speed of 500 revolutions per minute.

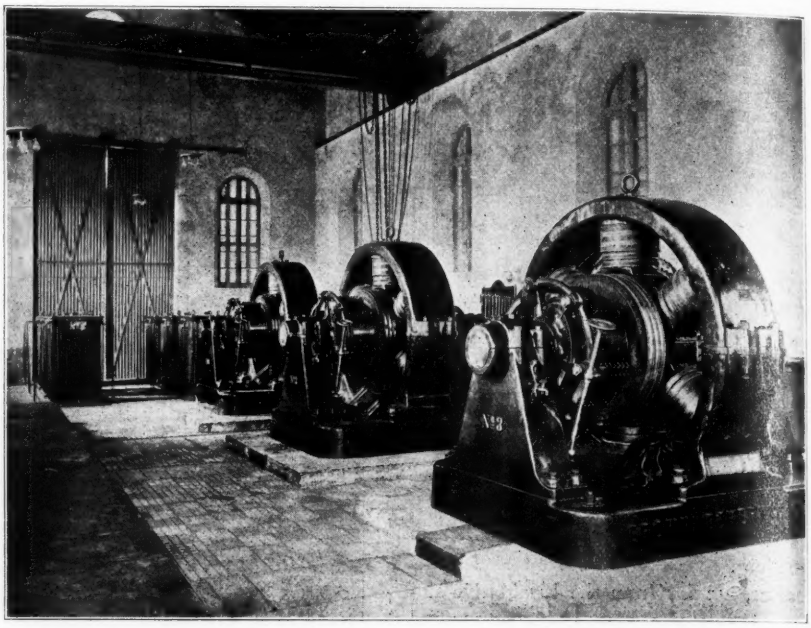


FIG. 4.—ROTARIES AND TRANSFORMERS AT SUBSTATION, ALEXANDRIA-RAMLEH ELECTRIC RAILWAY.

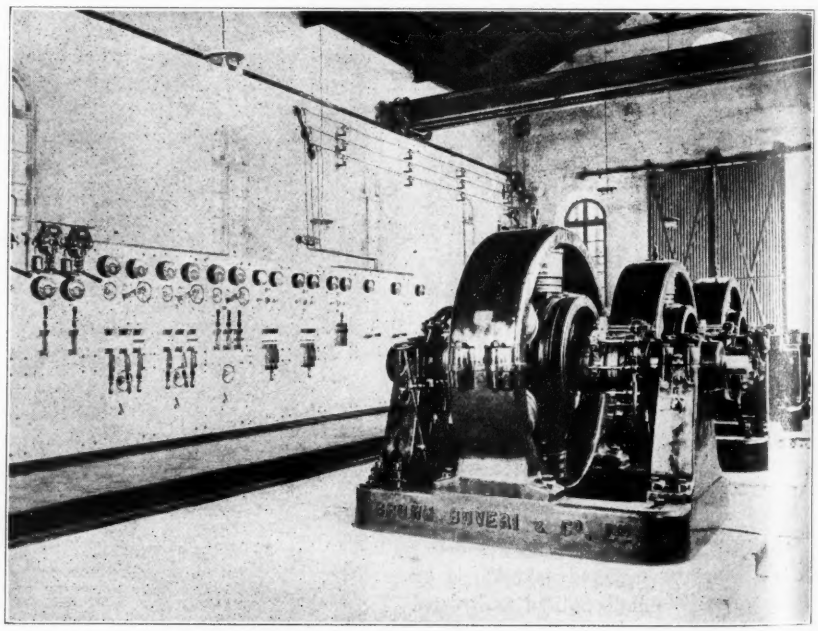


FIG. 5.—SWITCHBOARD AND ROTARIES, SUBSTATION, ALEXANDRIA-RAMLEH ELECTRIC RAILWAY.

At the Bulkeley substation the same general scheme has been adopted for distribution. There are three separate groups, each consisting of three single-phase trans-

formers and the corresponding rotary converters. This arrangement allows bus-bars to be eliminated for the low-pressure alternating current, and simplifies notably the arrangement and manipulations of the switchboard.

The manipulations for starting a rotary converter and connecting it to the secondary of the transformer circuit are very simple. By means of a motor-generator set, consisting of an induction motor of fifty horse-power, coupled directly to a continuous-current dynamo rated at thirty-three kilowatts, driven at a speed of 750 revolutions per minute, the rotary converter is started as an ordinary continuous-current motor. Then, by means of the regulating rheostat, the speed of the rotary is increased so as to bring it into synchronism with the transformer currents, and it is then connected to the transformers so as to operate as a synchronous motor. An interesting detail of this installation is the supplying the rotaries with two series windings, in addition to the shunt winding. These may be connected either in series or in parallel. This is done with a view of obtaining, by means of induction coils applied in the alternating-current circuit, a variation in the voltage from 500 volts empty to 535 at full load, when the two compound windings are in parallel, or even to 550 when these two coils are in series.

The substation switchboard consists of three panels for the alternating currents, three for the direct currents supplied from the rotaries, and four panels for the feeders, each of which is provided with an automatic switch. These four feeders feed separately four different sections of the line—that is to say, that section running up from Alexandria to Bulkeley; the section going down from Bulkeley to Alexandria; the section from Bulkeley to St. Étienne on the old line; and the section from Bulkeley to St. Étienne on the new line.

In order to complete this installation, a 350-kilowatt rotary converter, shown in Fig. 6, has been placed in the generating station. This is fitted with auxiliary apparatus similar to that in the substation—that is to say, there is a group consisting of three single-phase transformers rated at 125 kilowatts, connected in delta, for lowering the alternating current to 350 volts. This rotary was installed to supply the railway in the city, and operates in parallel with the direct-current machines in the city station. The latter were supplied with an over-compound winding, so that the rotary was also supplied with a compound winding, by means of which the voltage of the direct-current side is raised from 500 at no load to 550 at full load.

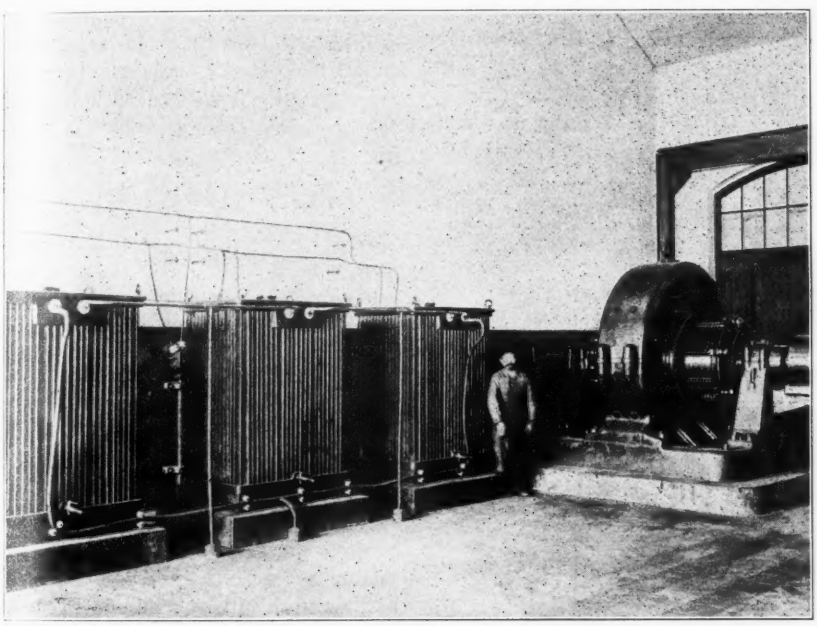


FIG. 6.—TRANSFORMER GROUP AND ROTARY CONVERTER, GENERATING STATION, ALEXANDRIA-RAMLEH ELECTRIC RAILWAY.

When, on account of the small load carried by the substation at Bulkeley during the early hours of the day and during the night, it is not convenient to keep in operation the 600-kilowatt unit, the machine just mentioned is run in order to transform the continuous current into alternating current. The dynamos at the central station thus furnish continuous current for driving the rotary, and the alternating current produced by the latter is raised by the transformers of the station from 350 to 6,500 volts, and is thus sent out over the lines. Finally, in order to prevent the rotary, which is thus run inverted, from racing, due to under-excitation, the exciter for this machine is directly coupled to it.

The passenger service on the Alexandria-Ramleh road is supplied by means of cars of the first and second class, as well as by combination cars with first and second-class compartments. The principal car-shed, placed at Mustafa, near the Bulkeley substation, is capable of storing seventy cars. A repair shop has been erected for carrying out the most important repairs, and is placed next to the generating station at Karmous.

The transformation from steam to electricity was carried out in a few months, but it is already possible to note the most satisfactory results from this transformation.

American Institute of Electrical Engineers.

On September 24, 1905, a law committee of five members of the American Institute of Electrical Engineers was appointed to prepare recommendations of such amendments to the constitution as would seem desirable, in view of the very greatly increased membership at the present time. The recommendations must be presented to the secretary on or before February 1, 1906, in order to secure action during the year. This committee is now engaged in the work, but in order that every member may have an opportunity to make suggestions of desirable amendments, an invitation has been extended to each member or associate to send suggestions to the secretary before December 15, 1905.

The Institute has prepared an attractive and useful folder containing the lists of officers, committees, and a calendar for 1905-1906.

The National-Interstate Telephone Association.

The National-Interstate Telephone Association has prepared a miniature emblem in the shape of lapel buttons, clasp pins and hat pins. This represents the official design, and is furnished in gold plate and colors. Exchange managers are purchasing these shields for distribution among employés and subscribers. J. A. Harvey, assistant secretary, 708 Electric Building, Cleveland, Ohio, is in charge of the distribution, the prices of the shield varying with the form preferred.

AN ELECTRIC ACCELEROMETER.[1]

BY R. B. OWENS.

The advent of the electric motor as a competitor of the steam engine, especially in the traction field, has given rise to certain acceleration problems unfamiliar to engineers of a generation ago. At a time when the train-mile was a satisfactory unit in which to reckon haulage costs, there was little occasion to bother with acceleration. Now, however, when neither the train-mile, car-mile nor ton-mile suffices, even when coupled with a speed factor as a basis of estimation and analysis, now when to maintain certain schedules more energy is expended in accelerating than in overcoming frictional and grade resistances, a simple, accurate and reliable means of measuring acceleration is urgently demanded—a means at least comparable in simplicity and accuracy to those employed in the measuring of the quantities of which it is the second and first differential with respect to time. The measurement of length is familiar to all. Of practical methods of measuring velocity or speed, at least of machines, one of the most satisfactory, if not the most satisfactory, involves the use of a suitable constantly excited or permanent magnet dynamo mechanically driven by the piece whose velocity is to be measured,

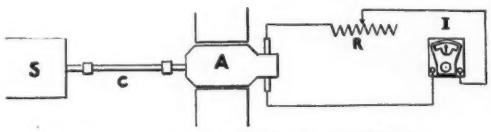


FIG. 1.—AN ELECTRIC ACCELEROMETER.

and electrically connected through an ammeter to a circuit of constant coefficients as shown in Fig. 1.

S is the shaft whose velocity is to be measured. C is a mechanical coupler. A is the armature of a small permanent magnet or constantly excited continuous-current dynamo wound so as to have a negligible reaction within the limits of its use. R is a variable non-inductive resistance, and I is a zero centre direct-current ammeter. The reading of I will be proportional to the speed of S and by adjusting R can be calibrated in the revolutions per minute, feet per second, or miles per hour as desired. As the current through I is proportional to speed, it is only necessary to determine the rate at which the current varies in order to have a measure of acceleration. This is simply and easily done by inserting in the circuit with I a transformer T with its secondary connected, for purposes of adjustment, through a non-inductive resistance R_1, to a zero-centre, direct-current voltmeter V (see Fig. 2). The reading of the voltmeter V will then be proportional to the acceleration, positive or negative, of the shaft S.

Substituting recording instruments for the indicating ones shown, we have a recording speed indicator and a recording accelerometer. The transformer must have a straight line saturation curve and a large transformation ratio, as the secondary induced voltage is necessarily small and the voltmeter V must also be sensitive. The calibration of the ammeter as a speed indicator is effected by driving the armature A at different constant speeds, as shown by ammeter reading, and taking the revolutions in a given time by means of a revolution counter and stop watch. The calibration of the voltmeter as an accelerometer is best done by driving the armature A by a separately and constantly excited motor having applied to its armature, preferably of small momentum, a voltage varying approximately as a linear function of time. With proper manipulation of apparatus the ammeter readings plotted against time will be a straight line whose slope will be constant and equal to the acceleration and to the constant reading of the voltmeter to within a constant.

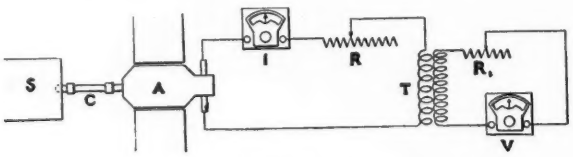


FIG. 2.—AN ELECTRIC ACCELEROMETER.

In some tests made in the writer's laboratory not long ago, A (see again Fig. 2) was the armature of a small, low-voltage, separately excited, direct-current generator; S the shaft of a three-horse-power, separately excited, direct-current motor to whose armature by a potentiometer arrangement a steadily increasing or decreasing voltage could be applied; I and V Weston ammeter and millivoltmeter and T a small lighting transformer with a transformation ratio of twenty, and excellent results were obtained, speed and acceleration being read to exactly the same degree of accuracy that Weston direct-current ammeters and voltmeters are capable of. With recording instruments substituted, this would seem to meet every requirement of a practical apparatus for the measurement and recording of velocity and acceleration in railway work, both steam and electric, and is applicable, of course, in many other connections.

[1] Paper read before the electrical section of the Canadian Society of Civil Engineers, November 2.

Electric Power Supply for London.

A report has been issued by the finance committee of the London county council, dealing with the question of electrical supply for that city. The two main questions on which the council desires the advice of this committee are the following: are there reasonable grounds for thinking that the plan proposed recently by the highways committee of the council will be self-supporting? second, can the large sum of money needed be raised without affecting the credit of the council?

The highways committee's report recommended the council to promote a bill in the next session of parliament, to enable the council to supply electrical energy in London and certain surrounding districts. The report of the highways committee offered no guidance beyond the general statement that, in its opinion, it would be quite practical to put forward a satisfactory scheme. At the last session of parliament a bill was introduced to authorize a power company to supply a large industrial and non-industrial section of London, of which not less than seventy-five per cent was outside the county of London. The capital to be used in this undertaking was put at about $33,000,000. A station with an output of 60,000 kilowatts was first to be erected, and distributing mains and subsidiary works were to be constructed at a cost of $10,500,000. This company estimated that it could generate electricity at the low price of 0.308 cent per kilowatt-hour, and that adding general expenses would bring the cost to 1.044 cents. It is estimated that with a scale of 133,500,000 kilowatt-hours by the year 1910, at the average price of 1.4 cents per kilowatt-hour, that there would be a balance, after

providing for reserve, depreciation and renewals, sufficient to pay five and one-half per cent on the capital of $10,000,000; and, further, that with a sale, by the year 1916, of 600,000,000 units at 1.1 cents, there would be a balance sufficient to pay four and one-half per cent on $5,000,000 debenture stock, five per cent on $10,000,000 of preferred stock, and eight per cent on $15,000,000 of ordinary stock, and leave a balance of about $190,000.

Taking the company's figures as a basis, the finance committee estimates that it will be necessary for the council to sell 200,000,000 units at an average of 1.4 cents per kilowatt-hour, in order to realize a profit on working of $900,000 a year, even should the working expenses prove to be no higher than those given in the above estimate.

It is thought that for the council's plan to be successful, it will be necessary to supply a large district lying outside of London county; but it is feared that there would be considerable difficulty presented to obtaining authority for it to do this.

The report submitted by the highways committee was indefinite on a number of points. It was not clear whether the council would be able to supply power directly to individual manufacturers, or would find it necessary to do so through existing companies. Nor was the highways committee able to estimate the amount of support which the council would be likely to receive from the local companies. For these reasons the finance committee views with apprehension the large addition to the council's capital which this undertaking would necessarily involve. The council is at the present time engaged in carrying out several great improvements and works involving a large amount of capital expenditure, and during the present year it decided upon the immediate electrification of the whole of the northern system of its tramways. This, with various extensions and other reconstructions, will necessitate a far larger capital expenditure on tramways during the next few years than in any past year. Again, the acquisition of a site for the new county hall has been approved, and provision for this, together with the building, will make a serious addition to its normal requirements on capital account. In these circumstances, and apart altogether from the consideration of the risk which the proposed scheme involves, the finance committee thinks the council should endeavor to find some solution of the problem which will not involve the raising by the council of large sums of capital in the near future.

In conclusion, the finance committee points out that the enterprise to which the council is being asked to commit itself is one of a somewhat uncertain character, on account of the possible developments of electrical science. It is being asked to commit itself, without any figures before it to show that the undertaking would be self-supporting. The finance committee is of the opinion that the council should be guided in the matter by its financial position, and that it should not largely extend its financial engagements during the next few years.

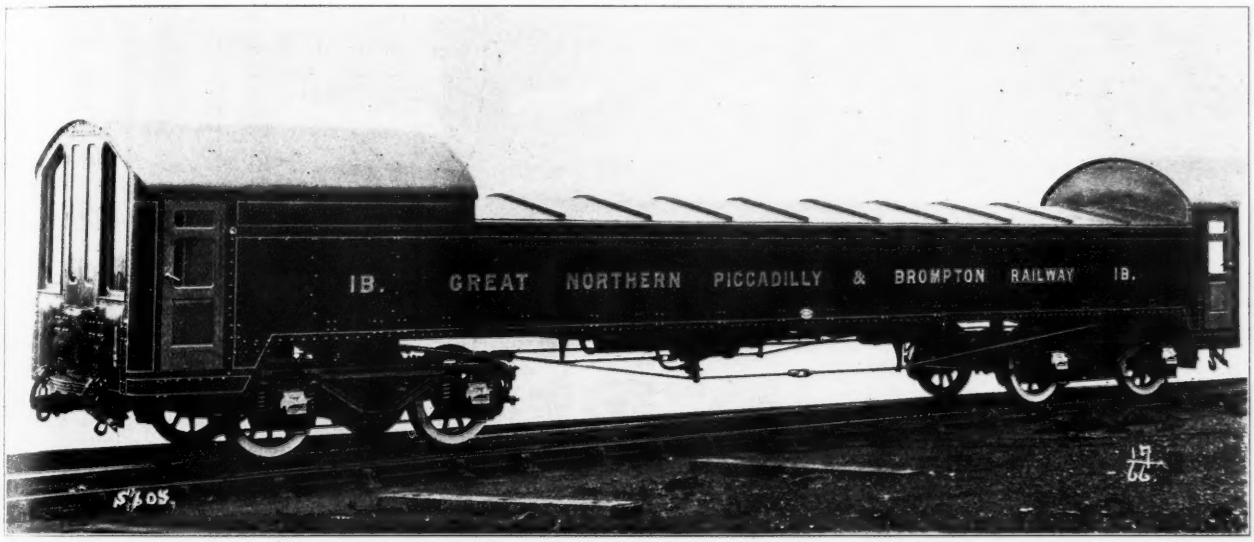
A UNIQUE STORAGE BATTERY LOCOMOTIVE ON THE LONDON UNDERGROUND RAILWAY.

BY FRANK C. PERKINS.

The accompanying illustration shows an interesting type of storage battery locomotive as utilized by the Underground Electric Railways, Limited, of London, for the Great Northern, Piccadilly & Brompton Railway. A number of these locomotives have been constructed at Motherwell, England, for use in this service by Hurst, Nelson & Company, Limited.

The bodies of these locomotives are fifty feet and six inches long, over the buffers, and are entirely constructed of steel, with the exception of the flooring which is of Jarra wood. The driver's cab is arranged at one end of the locomotive and is somewhat smaller than the compartment at the opposite end of the locomotive; the larger compartment or cab is provided with the necessary brake apparatus, the switchboard, electrical instruments and other electrical equipment.

The main battery compartment is located along the entire length of the locomotive between the cabs and is of low construction, with a steel top or roof. The storage battery compartment will accommodate accumulators having a total weight of thirty-six tons. These underground electric storage battery locomotives are fitted with hand-brakes as well as the modern Westinghouse air brakes. The accumulators were supplied by the Chloride Electric Storage Battery Company, Limited, Westminster, London. The



STORAGE BATTERY LOCOMOTIVE ON THE GREAT NORTHERN, PICCADILLY & BROMPTON RAILWAY.

locomotives, when the batteries are fully charged, are capable of hauling electric trains on the Great Northern, Piccadilly & Brompton Railway, and on any other line of the same gauge, regardless of whether there are any trolley connections or a third-rail conductor is provided. The electric storage battery locomotive is of particular interest on account of its large capacity, and great length. A greater portion of the storage battery electric locomotives that have been constructed in America have been utilized largely for shop and yard service, and are of small size, while electric storage battery cars have not been considered successful on the various experimental lines which have been constructed in Great Britain.

This new English storage battery locomotive is said to have given excellent satisfaction for the class of work for which it is required.

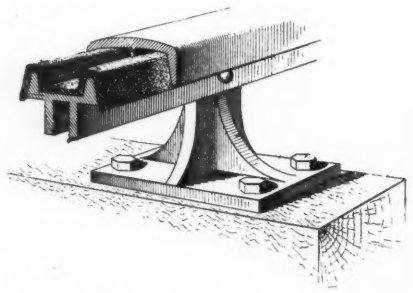
The storage batteries utilized consist of eighty cells, each of which has twenty-one plates to the element, and the normal discharge current is 179 amperes with a maximum emergency output of 800 amperes. The locomotive has a free running speed, when hauling train-loads of 120,000 pounds, of about nine and one-half miles per hour.

The electric controlling apparatus is of the British Thomson-Houston type.

The main floor is constructed of steel girders and plates and upon this is arranged a casing extending from one end to the other.

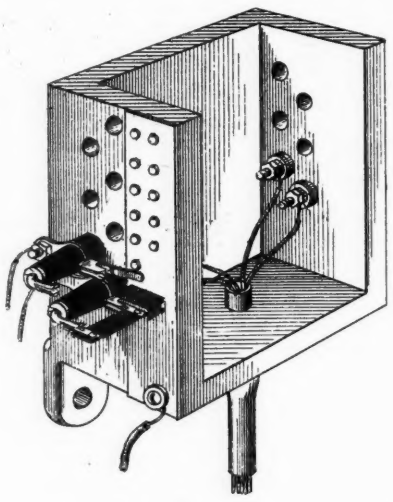
Electrical Patents.

Louis Steinberger, New York, N. Y., is the inventor of an electric rail, used more particularly for supplying current to electrical railways (805,166, November 21, 1905). Among the improvements contemplated by the invention are the following: first, to provide an efficient system for heating the rail, thereby keeping it clear of snow and ice; second, to render the heating mechanism readily accessible without incurring danger on the part of the operators; third, to provide thorough insulation between the rail and its support; fourth, to render the different parts of the support detachable, so that it may be readily taken asunder without causing much interruption in traffic; fifth, to concentrate the heat as nearly as possible to the contact surface of the rail; sixth, to confine and retain the heat near the contact surface and prevent absorption of the heat by the body portion of the rail or the rail supports, and seventh, to provide an enclosed chamber within the rail, so as to prevent radiation of heat in any direction except toward the contact surface of the rail. The rail comprises a supporting member provided with upwardly projecting flanges and with a bottom portion, these parts being of proper conformity to constitute a trough. A member of insulating material engages the flanges and the bottom portion, and a rail member rests upon the upper surface of the insulating member. Heating coils are connected with the rail member and are disposed intermediate of this and the supporting member.



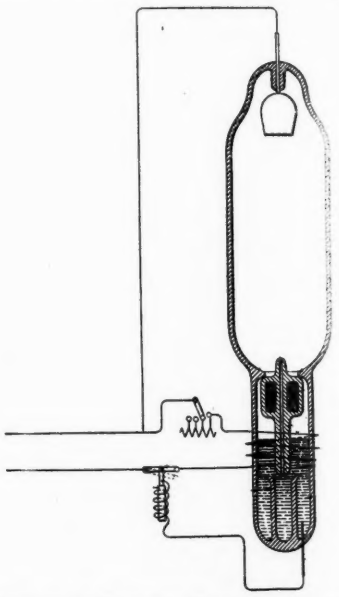
Combination Electric Rail.

A fuse terminal is the subject matter of a patent granted to Henry E. Procunier, Oak Park, Ill. (805,154, November 21, 1905). The purpose of the invention is to provide a conveniently applicable device of the nature of a lightning arrester in connection with fuse terminals for telephone or telegraph cables and like purposes, the same being specifically designed and adapted for use with the fuse terminals which are shown in letters-patent granted to Mr. Procunier on November 28, 1899, 637,894, for a terminal head-box. In this invention a base or supporting plate is provided and a conducting-post having a terminal for a fuse connection. An insulating sleeve on the post is stopped at one end thereon and is reduced back from the other end to extend into the base and form a shoulder. A second insulating sleeve is located on the reduced portion of the first between the shoulder and base. A conducting-plate is on this reduced portion between the shoulder and the second sleeve and has a second terminal for holding the fuse-plate. Located on the post at the opposite side of the base from the second sleeve is an insulating washer, and nuts are on the inner end of the post for binding all the parts together by longitudinal stress.



Fuse Terminal.

The Cooper Hewitt Electric Company, New York, N. Y., controls a patent on a method of starting electric gas or vapor devices, patented by Peter Cooper Hewitt (805,292, November 21, 1905). The invention relates to that class of electrical apparatus in which electric currents are caused to traverse an enclosed gas or vapor. The means which it is contemplated to employ for causing the ejection or squirting of a stream of mercury are in the form of a magnetically operated syringe, which will force a portion of the lower mercury electrode upward and into contact with the other electrode. Similar means may be employed for releasing the mercury, but these means may be varied, and it is also true that various other means may be provided for causing a closed circuit to be formed between the electrodes. After the electromagnetic devices have done their work they may be automatically cut out of the circuit or may be left in the circuit, if desired.



Method of Starting Electric Gas or Vapor Devices.

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

It is evident from a little study of conditions that many central stations have found it of no little benefit to make liberal outlay in order to institute educational methods as a means of stimulating the demand for current. From all parts of the country information is being received bearing upon the value of definite lines of action in impressing upon possible consumers the advantages of a large use of electricity.

The Chattanooga Electric Company, Chattanooga, Tenn., under the capable direction of Mr. Byron T. Burt, general manager, has established a department of electrical household articles for the sale of electric flat-irons, chafing-dishes, disc-stoves, coffee-percolators, etc., this department being placed in charge of a reliable lady solicitor. Very frequently the company indulges in half-page advertisements in the daily newspapers, calling attention to the advantages of domestic electrical appliances, and announcing demonstrations. Quite recently the company fitted up its show-windows and showroom in the most elaborate fashion, and held a practical demonstration of the utility of electrical appliances. The accompanying illustrations show the remarkable effect produced by this display. The company, in addition to furnishing free lamp renewals for its lighting circuits, is about to take up the proposition of renewing, free of charge, all cartridge-heating units for flat-irons. Outside of all this, publicity is carried on under a definite campaign, which includes the getting together of classified lists of prospective users of light and power, following these lists up by circular-letters to the builders of new houses, and the mailing of illustrated booklets and syndicated matter. The company also furnishes all prospective customers with a little booklet on the advantages of light and power, giving the rates and examples of the methods of charging. A very useful publication which is also distributed, is the "Handbook for Power Users." This book is replete with the most interesting information concerning the possible forms of equipment, and tables of data which can be used to advantage by the prospective consumer.

A Display of Domestic Electrical Apparatus by the Chattanooga Electric Company.

A Display of Domestic Electrical Apparatus by the Chattanooga Electric Company.

According to the season of the year, the company uses more or less advertising space in the daily newspapers, contracting each term for a specified number of inches.

No house wiring is undertaken by the company, but its solicitors get bids from the wiring companies and endeavor in every way to help the prospective customer to get the wiring done as cheaply and permanently as possible.

Reviews of Current Engineering and Scientific Literature.

The Uses of the Rare Earths.

The so-called rare earths constitute almost a quarter of the number of chemical elements known. Until recently they were not applied to any commercial purpose. In this article Professor Charles Baskerville discusses the use of these elements for illuminating purposes. These earths are conveniently classified under three groups: cerite earths include cerium, lanthanum, praseodymium, neodymium, samarium, gadolinium, europium; yttrite earths include yttrium, erbium, terbium, ytterbium, scandium, holmium and thulium; the zirconium group includes zirconium and germanium. Titanium used to be classified in the third group, but it is no longer regarded as a rare earth. As early as 1826, Drummond evolved the limelight, which depends upon directing an oxyhydrogen flame on a pencil of calcium oxide. Bituminous coal gas was substituted by du Motay in 1867. Lime does not answer the purpose well, because it slacks when not in use; so a plate of zirconium oxide was substituted by Linnemann. Koch also employed pieces of zirconium for medical purposes. Others employed similar materials for illumination purposes, but none of the arrangements was of much importance until, in 1885, Auer obtained his first patent for the incandescent gas-mantle. His best mantle is composed of ninety-nine per cent of thoria and one per cent of ceria. At that time the price of thorium nitrate varied from $125 to $500 per kilogramme, but, due to the increasing use and the new sources of supply which have been discovered, the price has since dropped to about $7 to $10 per kilogramme. The next important development was the use by Nernst of these oxides, for preparing the Nernst glower. He first used a cylinder of magnesia. To this latter was added boric acid, calcium chloride and tungstic acid and other oxides, in order to improve the conductivity. Wedding has prepared a zirconium lamp by submitting the zirconium oxide with magnesium to the action of hydrogen at high temperatures. The alloy obtained is pulverized, and on the addition of a cellulose solution, it is transformed into a plastic, homogeneous mass, from which the filaments are drawn. The filaments are then carbonized in an atmosphere free from oxygen, and present a metallic appearance. One pound of zirconium is sufficient for 50,000 filaments. The voltage of these is low, so that it is generally necessary to place three in series on the usual 110-volt circuit. Wedekind states that rhodium is added to the mixture in preparing the zirconium filament in order to obtain the necessary conductivity. Adel has made filaments for incandescent lamps from vanadium, thorium, columbian and their alloys. Three other filaments for incandescent lamps are referred to briefly by the author, although they are not made of the rare earths. These are the osmium filament of Welsbach, the carbide filament of Voelker, and the tantalum filament of von Bolton.—*Abstracted from the Engineering and Mining Journal (New York), November 25.*

Reading Error of Indicating Instruments.

Dr. Byron B. Brackett shows in this article the varying weights which errors may have, due to inaccurate reading of electrical instruments. Even when such instruments have a uniform scale, an error of constant length in the reading will affect the accuracy of the reading, and in different degrees. When an instrument of the direct-reading type is read there is an uncertainty of about one-tenth of a scale division. Plotting this uncertainty as ordinates and the values of the scale divisions as abscissæ, the inaccuracy curve is found to be an equilateral hyperbola having its asymptotes for axes. Since the smallest of the scale divisions of an instrument having a range of 100 amperes in general represents one ampere, the error due to the uncertainty of the position of the pointer will at this point be ten per cent, while at the other end of the scale it will be but one-tenth per cent. At the lower part of the scale the uncertainty increases in a remarkable way. If the instrument have a longer pointer, or if its deflections are measured in a more accurate manner, the uncertainty will be less, but the same conditions and the same relations exist. When a direct-reading instrument has a scale that is more open at its middle, with smaller divisions at the ends, the uncertainty of low readings is necessarily greater, and the point where reasonable accuracy may be secured is not reached until the quantities measured are relatively much larger. Moreover, the reading accuracy for such instruments usually diminishes for the last one-third or one-fourth of the range of the instrument; hence the reading error of such an instrument would be represented by a curve which would differ from the hyperbola above mentioned by rising more rapidly when the readings become small, and rising again toward the maximum range of the instrument. In the use of any indicating instrument the reading error for all parts of the scale should be accurately known, and if it is not understood for any particular type, the curve should be plotted and thoroughly fixed in the mind. There are two reasons why those using instruments should understand the limits of accuracy in reading as thoroughly as they understand their liability to error. The first is that no precautions need be observed or corrections made when they deal with errors that are less than the probable reading error; second, while it is in itself desirable to use instruments of such ranges that the readings are well up on their scales, yet there are cases where low-reading voltmeters, with their low resistances, and low-reading ammeters, with their high resistances, will introduce important errors caused by the changed conditions resulting from their introduction into the circuits. Questions are thus continually arising as to whether the error inherent in a low-range instrument, plus its small reading error, will be greater or less than the larger reading error of a higher-range instrument having all of its errors of negligible magnitude. Only a definite acquaintance with the reading of error curves for the instruments that may be used will enable one to decide which instruments should be selected for any specific test.—*Abstracted from the Electric Journal (Pittsburg), November.*

Disturbing Influences of Electric Tramways on Magnetic and Electrical Measuring Instruments.

The disturbing influences which may be caused to magnetic and electrical measuring instruments in research laboratories, and the means which may be adopted for preventing or minimizing these troubles, are here discussed by Professor Charles Maurain. The disturbances may be due to magnetic fields set up by the line current, but this is not a likely trouble. One more liable to occur is due to the magnetic fields caused by stray currents from the ground circuit. These disturbances are sometimes so great that studies of ter-

restrial magnetism have been abandoned. They also affect seriously galvanometers of the movable-needle type, and magnetometers. To prevent them, the location of a new laboratory should be studied with care. It will generally be found desirable to place such buildings outside of cities, since then it is easier to keep the tramways at a distance, and there is, further, less disturbance from vibration. The site selected should have firm soil, and if a tramway be in the neighborhood, it is better to be on the convex side of the line than on the concave. Generally, it will be found that a projected tramway is of such public importance that it can not be stopped. Means for diminishing the effect of the stray currents have been studied, particularly by Fröelich, who placed earth plates in the ground and led the current thus collected through circuits arranged in the building. He found that in this way the disturbances might be reduced to twenty or twenty-five per cent of their original value, or even to five per cent; but it is difficult to obtain in this way a protection which is sufficiently constant. To protect apparatus against stray fields, magnetic screens might be used, but since these must be very heavy, even for small apparatus, it is obviously impossible to adopt such an arrangement for protecting a building. Galvanometers of the D'Arsonval type may be used, since with these instruments the effect of the stray fields is negligible. Du Bois has studied carefully the use of magnetic screens, and has devised means of protecting in this way galvanometers of the movable-needle type. The theory of this method is discussed here briefly. In magnetometric studies the difficulty may be overcome by placing the magnetized bar vertical, as usually a spot in the laboratory may be found where the change in the vertical component is negligible. It is concluded that these tramway disturbances are so important that the director of a physical laboratory should always take some action when a new electric railway is projected. While he can not prevent the road, he should urge the necessity of avoiding the neighborhood of the laboratory building as far as possible, and he should insist that the road take all precautions to prevent disturbances. Auxiliary conductors of low resistance should be laid in the vicinity of the laboratory. The road should also be held liable for such damage as it may cause. A number of instances are mentioned, in which the road was forced to supply the laboratory with new instruments. In the case of the building at Vienna, the road agreed not to lay any tracks within six metres of the building, and to carry its feeders underground and on the far side of the track with respect to the building, laying the positive and negative conductors not more than ten centimetres apart and at the same depth. The company also paid to the institute $12,000. At Charlottenburg the railway company furnished the institute with twenty-one new galvanometers. It was prohibited from using overhead wire at this point, and the road was cut into two sections, each section being fed from an independent power-house. It was agreed, further, that in case another line should be laid on another street, that this section would be operated from an independent power-house also. None of these power-houses is to be within one kilometre of the institute, and in order to reduce, as much as possible, vibration of the building, the cars are required to pass it at a reduced speed.—*Translated and abstracted from La Revue Électrique (Paris), November* 15.

Electric Power in Sewage Disposal Plants of the Birmingham Tame and Rea District Drainage Board.

The Birmingham Tame and Rea district drainage board has recently put into service an interesting sewage disposal and electric power supply. The object of the scheme is to enable the board to pump sewage up to a strip of land adjacent to and situated at a higher level than the main conduit, which conveys the sewage from the outfall works within the city of Birmingham to the sewage farm located near Tame valley. Apart from pumping sewage, the power-transmission scheme is employed to drive motors at various places along the valley to drive sewage screening, rakes, sludge elevators, sewage distributors, workshop appliances, farmyard machinery, lighting and other similar work. The plant consists of a power-house, a destructor and five brick pumping stations, with provision for a substation in each. There are five miles of overhead line, with crossings underground, and complete equipment at the generating station and substations. The generating station is situated near the Saltley boundary of the board's estate. It contains two 115-kilowatt, alternating-current generators, each directly driven by a high-speed engine. These are designed to give their output at 2,250 volts, fifty cycles. Each is fitted with a direct-connected exciter, but there is in addition a small fifteen-kilowatt, 220-volt, continuous-current, steam-driven machine. The latter is employed for operating arc lamps at the sewage beds, to light the station and to furnish exciting current, should it be necessary. The engine room and boiler room are fitted with two alternative systems of lighting—one from the direct-current unit mentioned, and the other from the alternating-current bus-bars by means of a step-down transformer. The overhead line consists of hard-drawn copper, of such size that the maximum drop will be only seven and one-half per cent at full load. Throughout the length of the overhead line a barbed-wire is carried on the tops of the poles and earthed at frequent intervals. From the generating station the line proceeds to the drainage board's Saltley farm, where it is led into a substation containing three transformers, each of five kilowatts capacity and the necessary switch gear. These transformers supply power to three two and one-half-horse-power motors driving sewage screens, and one eight-horse-power motor driving farming machinery. From this substation the line is carried to the Trout Pool pumping station, where there is a six-inch centrifugal pump direct-connected to a three-phase motor. This raises about 700 gallons of water per minute against a head of sixteen feet. The transformer equipment consists of two four-kilowatt, single-phase transformers. The pumping station at Bromford, which is the next substation on the line, contains a similar equipment. At Ashold the pumping station contains a seven-inch pump, designed to raise 900 gallons per minute against a head of thirty-two feet. This is directly driven by a twenty-two-horse-power, three-phase motor. The transformer equipment consists of three single-phase transformers, each rated at ten kilowatts. There is in addition at this station a three and one-half-horse-power motor driving an elevator similar to the one at Tyburn, which is the next station on the line. This substation contains three fifteen-kilowatt and three seven and one-half-kilowatt, single-phase transformers. The former are for the power-circuits, and the latter for the lighting. The motor equipment here consists of one eight-horse-power motor and one eleven-horse-power motor used for driving general farming machinery. There is also an eight-inch centrifugal pump designed to raise 960 gallons of water against a head of thirty feet, which is driven by a twenty-horse-power, three-phase motor. At the next substation, which is at Plant's Brook, there is a ten-inch centrifugal pump, designed to raise 1,900 gallons per minute against a head of seventeen feet. This is direct-connected to a twenty-eight-horse-power, three-phase motor supplied from three ten-kilowatt, single-phase transformers. All the motors operate at 200 volts. The estimated cost of the entire system, including buildings and electrical machinery and overhead line, was a little over $90,000. The destructor plant cost about $88,000.—*Abstracted from the Electrical Engineer (London), November* 17.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Electric Elevators.

The Otis Elevator Company, New York city, in a recent catalogue presents some new types of electric elevators for passenger and freight service. Fig. 1 shows the Otis electric elevator engine equipped with a duplex worm-gear having screws cut from a solid steel forging, the right and left-hand threads intermeshing with two intermeshing phosphor bronze worm-wheels, eliminating end thrust and adapting the machine to high-car speeds and capacities beyond the limits of the single-worm type.

A powerful magnetic brake on the worm shaft holds the winding machine immovable whenever the car is stopped, or in the event of the operating current being interrupted or cut off from any cause. This type of machine is installed to operate cars having the highest travel of any electric elevators in any commercial building in the world, having a travel distance of 326 feet.

Fig. 2 shows a duplex worm-gear engine, which is a combination machine for freight and elevator service. This engine is designed so that the armature shaft is ordinarily directly coupled to the worm shaft, and the car operated at the speed and to lift the load required to meet the conditions of regular passenger service. It is so arranged, however, that this direct coupling can be disconnected and a back gear thrown in, largely increasing the lifting capacity and reducing the car-speed proportionately. This change can be readily and quickly made by any engineer or mechanic capable of taking care of the machine in ordinary service. Where electric elevators for passenger service are sometimes called upon to lift safes or other heavy freight, this combination machine is of great practical value.

FIG. 1.—ELECTRIC ELEVATOR ENGINE.

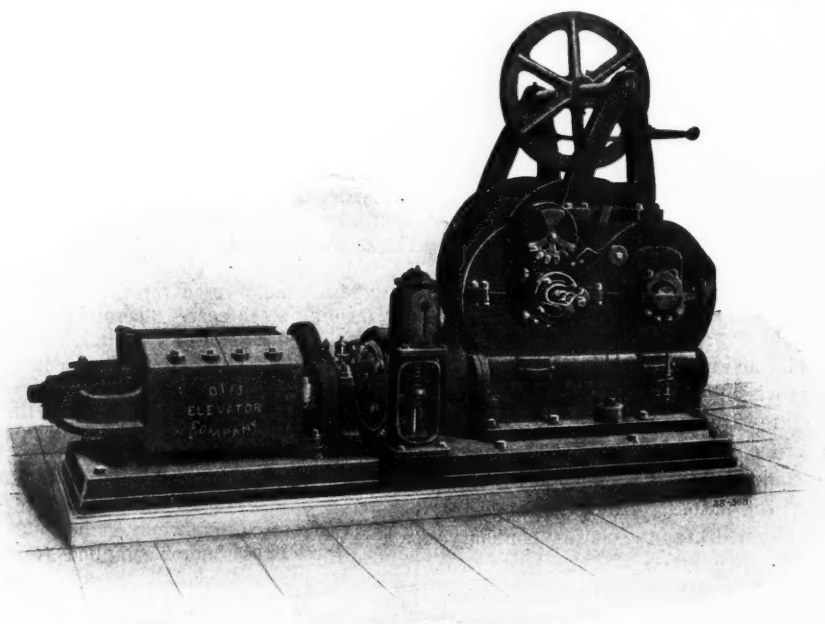


FIG. 2.—COMBINATION PASSENGER AND FREIGHT ELECTRIC ELEVATOR ENGINE.

Fig. 3 shows the Otis internal-geared electric elevator engine. This engine is designed and built for heavy freight service with a comparatively low platform speed. All parts of the machine are built extra heavy to meet the strains which will be imposed upon them. The machine is provided with a semi-magnet control, and arranged to be operated from the platform by means of a hand cable. For warehouses, automobile garages and other buildings where heavy loads are continually lifted, this machine is particularly adapted.

Fig. 4 shows the Otis electric dumb-waiter engine, and Fig. 5, the control board. This apparatus may be located above or below the hatchway, and is ordinarily built with automatic push-button control which can be arranged to meet the requirements of any situation. In addition to the automatic control, the machines may be arranged so as to be controlled mechanically.

Opportunities for Trade in the Far East.

Recognizing the great opportunities for trade in the Far East, Messrs. Bowring & Company, 17 State street, New York city,

some time ago sent Mr. E. R. Duer, the head of its export and import commission department, to the Orient to make a first-hand investigation and establish business connections as seemed desirable in that field. After a thorough investigation, at the close of the war, Mr. Duer arranged with Messrs. Cornes & Company, one of the oldest English houses in Japan, having establishments in both Yokohama and Kobe, to act as Japanese representatives. The business of Messrs. Cornes & Company covers a widely diversified field, including fully equipped engineering and electrical departments, both of which are under the supervision of competent engineers. Messrs. Bowring & Company has since succeeded in obtaining several agencies in the Orient for prominent American manufacturers. The company also has specifications in hand, and has secured prices on various machinery and appliances required for the remodeling of the imperial Japanese naval arsenals. The company has other negotiations under way, and is sanguine of soon arranging for a full line of Japanese agencies for American manufacturers of engineering and electrical apparatus and supplies. According to the latest devices, the company's representative, Mr. Duer, was last in China. After covering this field he will visit the Philippines and possibly Australia, where the company is represented by Robert Little & Company, of Sydney. The company also has an agency in Buenos Aires, Argentine Republic, where it is shipping a considerable amount of American-made goods.

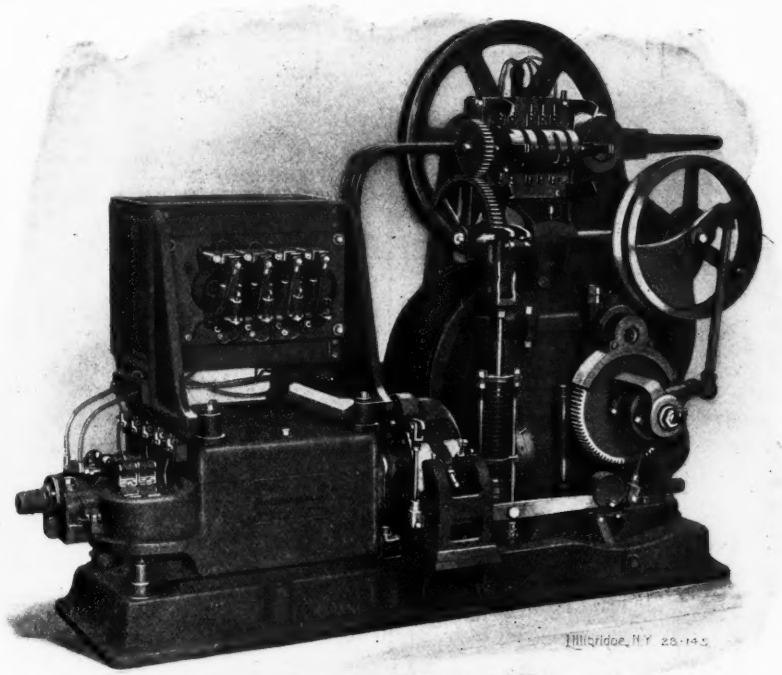


FIG. 3.—INTERNAL-GEARED ELECTRIC FREIGHT ENGINE.

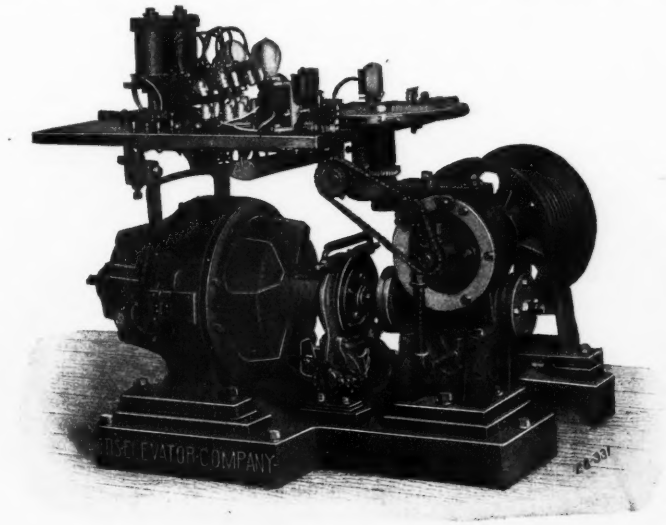


FIG. 4.—ELECTRIC DUMB-WAITER ENGINE AND SWITCHBOARD.

The Rail Joint Company.

The Rail Joint Company is the corporate name of the company recently organized under the laws of the state of New York, acquiring the business and property of the Continuous Rail Joint Company of America, the Weber Rail Joint Manufacturing Company, and the Independent Railroad Supply Company. The new company will carry on the business of the three companies substantially as it has been conducted in the past.

The board of directors is as follows:

Frederick T. Fearey, president; George G. Frelinghuysen, chairman of executive committee; L. F. Braine and Percy Holbrook, vice-presidents; F. C. Runyon, treasurer; Benjamin Wolhaupter, secretary; Mark T. Cox, George A. Weber, Edward Y. Weber, Marcus L. Ward and Charles P. Wheeler.

The offices in New York city in the Empire Building, and in the Century Building, Newark, N. J., will be consolidated with headquarters in the new office building at 29 West Thirty-fourth street, New York city.

Printing-Press Industry.

Because of the fact that the Westinghouse Electric and Manufacturing Company makes the largest units required for the production and transmission of electricity, comparatively few people know that in the same works at East Pittsburg are manufactured also the smallest units to meet the needs of printing establishments and similar lines of industry. It is a matter of considerable gratification to the company to see the favor with which its motors for the printing industry have been received. There have very recently been closed three contracts aggregating in the neighborhood of 400 motors, and the company is in position to undertake the equipment of printing establishments from the smallest to the largest machines required in this industry.

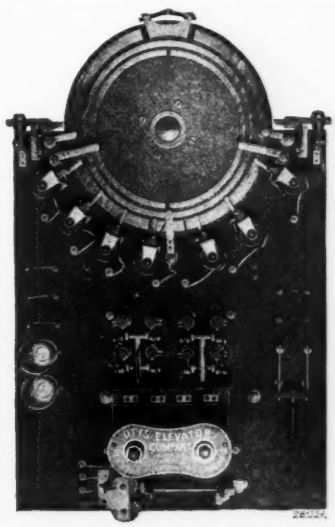


FIG. 5.—CONTROL BOARD.

The Storage Battery Installation of the Buffalo Savings Bank.

The Buffalo (N. Y.) Savings Bank was incorporated May 9, 1846. The directors of this institution have been progressive, and, among other details of development, have made certain that the architectural features of the bank building would be carried forward in the most up-to-date manner. The illustrations herewith give a good idea of the exterior and interior appearance of the bank building, the construction being modern in every respect. The bank operates its own electrical plant, located in the basement of the building. The electrical equipment consists of two Diehl generators, one of seventeen and one-half kilowatts, and the other of thirty kilowatts capacity. These machines run at 220 volts, and are driven by Otto gas engines of twenty-seven horse-power and fifty horse-power, respectively. There is also one eight by ten-inch triplex Gould hydraulic pump, electrically driven by a twenty-five-horse-power Crocker-Wheeler motor. The plant is operated from 8 A. M. to 6 P. M. The small engine and generator are run from starting time until noon, the load between these hours being principally that of the elevator. At about the noon hour the larger engine and generator are started up and carry the elevator and lighting load until the plant

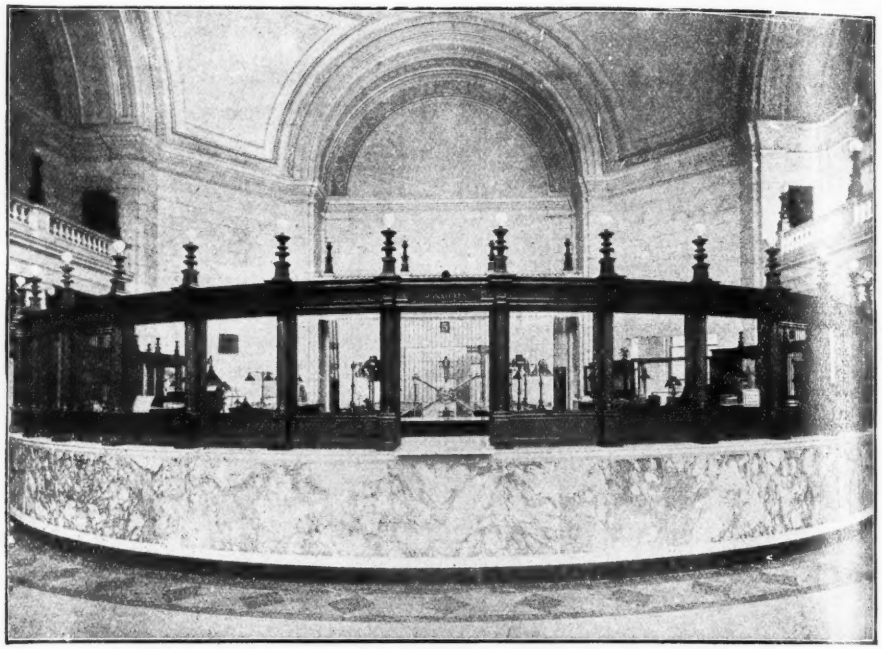
PORTABLE STORAGE BATTERY EQUIPMENT FOR ILLUMINATING BANK VAULTS.

is shut down. This schedule is varied when the weather is dark and threatening, or during thunder-storms, when it is necessary to start up the large engine and generator to carry the lighting load thus suddenly thrown on.

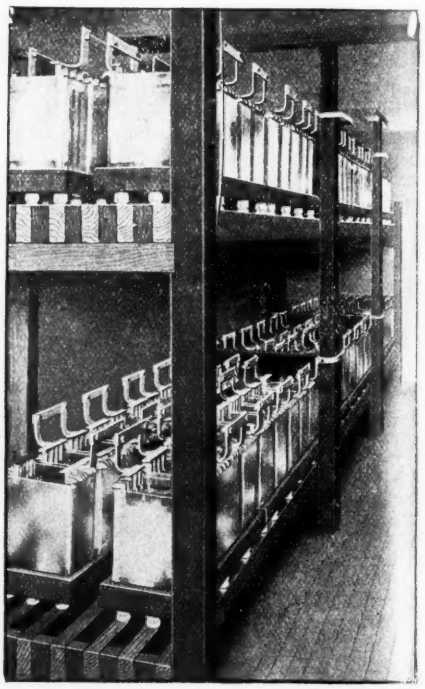
In August, 1903, this electrical equipment was augmented by the addition of a storage battery auxiliary, which consists of 114 cells of type V-7 "Unit Accumulators," manufactured by the National Battery Company, Buffalo, N. Y.

The storage battery installation has a normal capacity of 120 ampere-hours at 220 volts, and was installed primarily for the purpose of supplying current to the twelve lights in the large clock in the dome of the building. These are kept lighted until about 2 A. M. From 6 P. M. to 8 P. M. the battery supplies current for twelve hall lights. It also supplies current for any light needed by the charwomen in the morning from six o'clock until seven o'clock. The bank attorneys frequently work in the building from 6 P. M. until 11 P. M., during which time the battery supplies current for the lamps that they require. During the daytime the battery floats on the line, absorbing the fluctuations caused by the sudden starting of the elevator.

Storage batteries are also very convenient in bank buildings for lighting the book and cash vaults. The National Battery Company has a considerable demand for storage batteries for this purpose. The illustration herewith shows a convenient form of portable battery, to which is connected a flexible lead and lamp. These batteries are assembled in hardwood cases of from one to five cells per case, according to the voltage desired, ranging from two to ten volts, with a normal capacity of from twenty to sixty ampere-hours. The small lamps used with these batteries range from four to six volts, and from one to eight candle-power. If desired, two or more lamps may be connected in multiple and run from the battery.



ROTUNDA OF THE BUFFALO (N. Y.) SAVINGS BANK BUILDING.



STORAGE BATTERY ROOM, BUFFALO (N. Y.) SAVINGS BANK BUILDING.

A New Trough-Section Bar-Grid for Storage Batteries.

The accompanying illustrations give a good idea of a new form of grid invented and patented by Mr. William Gardiner, of Chicago, Ill. This bar-grid contains a

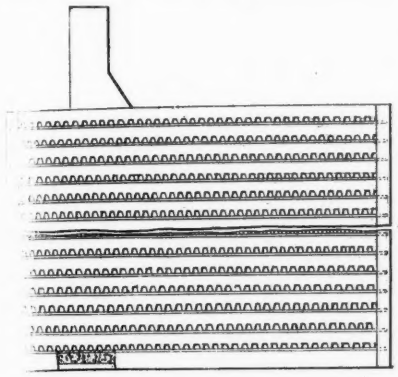


FIG. 1.—ASSEMBLED GRID.

gh section, which encloses almost all he active material, exposing none and enting a complete metallic surface to electronegative solution. Fig. 1 shows

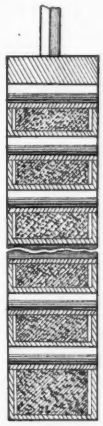


FIG. 2.—CROSS-SECTION OF GRID.

the assembled grid; Fig. 2 is a cross-section of the grid; Fig. 3 the "filled" cross-bar trough, and Fig. 4 the bottom of the cross-bar, showing the circulating device.

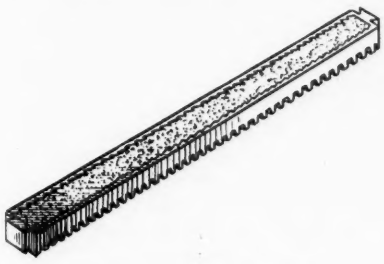


FIG. 3.—CROSS-BAR TROUGH.

Another feature of this storage battery is the absence of non-conducting separators. The section-bars, as illustrated, are in electric contact with each other. There is no lost surface, and the internal resistance is said to be extremely low. In exhaustive tests, covering nearly a year

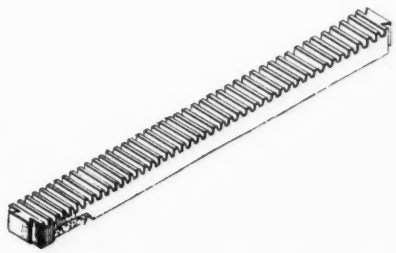


FIG. 4.—BOTTOM OF CROSS-BAR, SHOWING METHOD OF CIRCULATION.

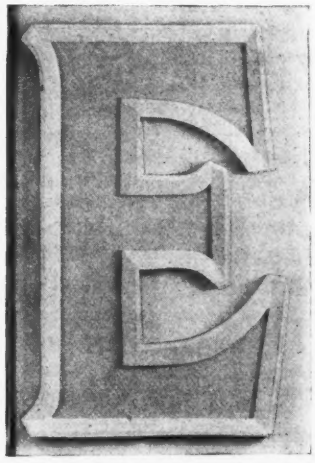
of service of the Gardiner grid, it is claimed that practically no surface disintegration took place. At the same time, by carefully filtering the electrolyte, there appears to be no evidence of wash or shedding.

Owing to the unusual metallic surface, it is claimed that it is possible to submit this grid to great abuse. Overcharging and excessive discharging cause no injury, and when using the Gardiner grid at normal, or eight-hour rating, the electromotive-force line is above two volts for seventy-five per cent of the total capacity.

During the past five years Mr. Gardiner has secured nearly two hundred patents referring to storage batteries. For the past decade he has been actively associated with the Pullman Company, the Helios-Upton Company and the Exmoor Company, and latterly as consulting engineer for the Universal Electric Storage Battery Company.

Day and Night Electric Signs.

The Day and Night Electric Sign Company, Easton, Pa., has placed on the market a novel electric sign. This sign is made up of unit letters mounted on zinc sheets which are interlocking. In assembling a sign, each sheet locks into the one immediately preceding and following it. The joints are hammered down flat, the zinc background of the letters being coated with smalt, making the joints invisible. It is a simple matter for any one to arrange a sign, and with a small stock of unit letters kept on hand, any desired effect may be produced.



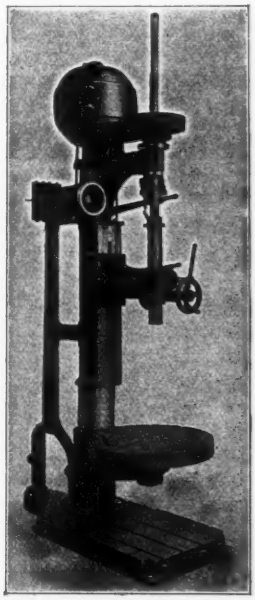
INTERLOCKING LETTER.

The letter proper is made of a translucent fabric built on a woven-wire foundation. This fabric distributes the light received from incandescent lamps arranged behind the sign so that the illumination is uniformly diffused over the whole letter. In this way any tendency to light spots is obviated, and it is claimed that a smaller number of bulbs can be used for effectually illuminating the sign area.

A raised and gilded carving outlines the translucent substance, and the letters are claimed to be practically indestructible. The sign is not only a conspicuous figure for night illumination, but is also readable and of great attractiveness in the daytime.

An Electrically Driven Drill Press.

The adaptability of electricity as an economical transmitter of energy is well illustrated by the accompanying engraving



ELECTRICALLY DRIVEN DRILL PRESS.

of a thirty-inch drill press run by a Crocker-Wheeler semi-enclosed motor. The drill was formerly belt-driven through a cone pulley-countershaft in the crutch of the back brace and another cone pulley-shaft at the top communicating with the spindle through a bevel gear. The shaft, cone pulleys, belts and bevel gears were

all removed and a Crocker-Wheeler vertical type motor substituted.

A glance at the illustration will show, even to the unpractised eye, the great gain in simplicity and general eliminating of moving parts. The variations of speed are obtained solely through the motor, which is supplied with current on a four-wire multiple-voltage system. The spindle speeds range from 51 to 276 revolutions per minute.

Electric Emery Grinders.

The Stow Manufacturing Company, Binghamton, N. Y., has placed on the market several forms of electric emery grinders of both the stationary and portable types, embodying the special construction of the Stow variable-speed motor. Fig. 1 shows a Stow semi-portable electric emery grinder. This machine takes two eighteen-inch by two-inch dry wheels, or one eighteen-inch by two-inch dry wheel, and one twelve-inch by one and one-half-inch wet wheel. The mechanical construction of these machines, the company claims, is excellent, and the advantages claimed are largely possible through the use of the multi-speed electric motor. These motors are mechanically regulated, no rheostat being used. It is possible, with the use of this motor, to grind at any conceivable speed between the highest and lowest points, the operator having control over the exact speed which will best conform to the work in hand.

The illustration shows the relation of the different parts. The wet wheel is mounted on the left side of the motor, and is properly encased. The water tank below the wheel may be lifted to any desired height by a turn of the vertical rod shown on the extreme left. The level of the water is thus raised in contact with the wheel, and an even distribution is made possible. Both wheels are provided with conveniently detachable rests for grinding, and the wet wheel has a catch-pan, into which the spray is thrown and returned to the water tank. A cast-iron water-pot is conveniently located between the wheels.

The motor is started and stopped by turning the short lever on the motor to the right or left. The speed variation is secured by turning the hand-wheel on the top of the motor. As is well known, a plunger is moved up and down within the core of the field coil, varying the magnetic path and bringing about the speed changes necessary for operation.

Fig. 2 shows a three-inch by twenty-four-inch electric emery grinder. This machine is constructed along lines similar to that shown in Fig. 1, but is heavier in all its parts. The motor is of greater horse-power, and it has a wider range of speed.

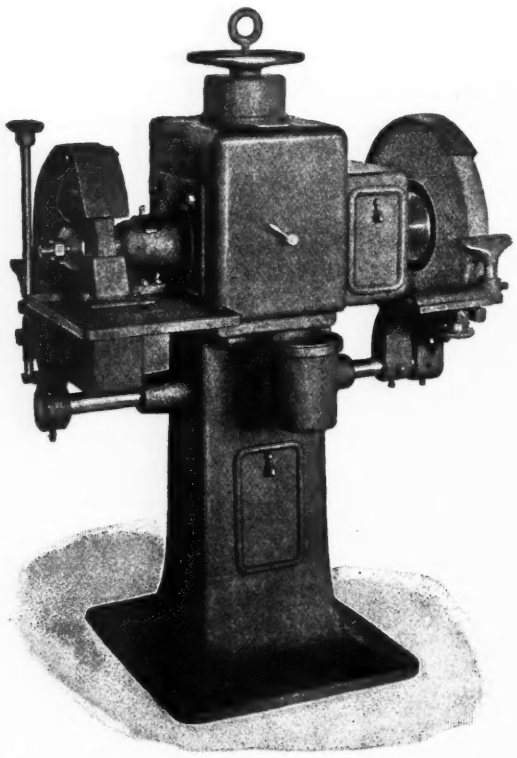


FIG. 1.—SEMI-PORTABLE ELECTRIC EMERY GRINDER.

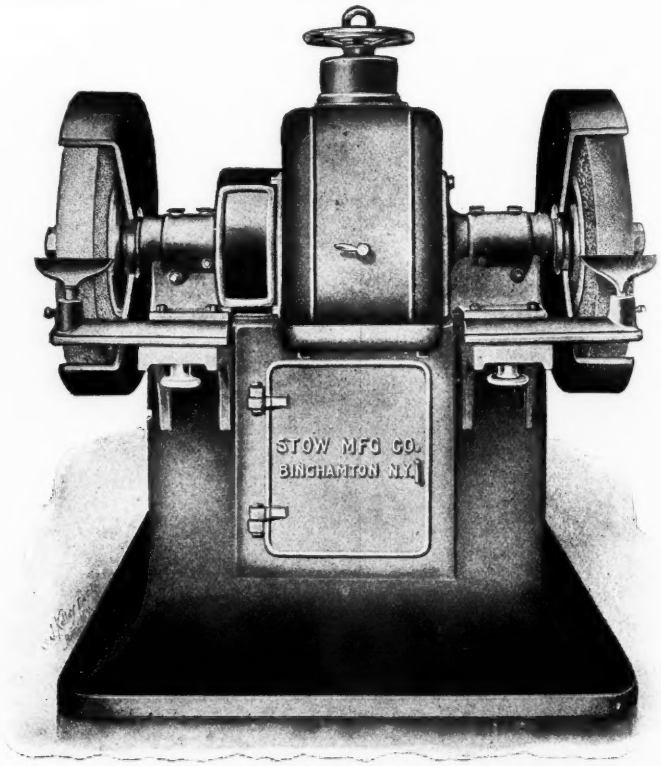


FIG. 2.—HEAVY DUTY ELECTRIC EMERY GRINDER.

New York Central Lines.

A general advertising department has been established in charge of Mr. George H. Daniels as manager, with offices in the Grand Central station, New York city, for the New York Central line as follows: New York Central & Hudson River Railroad, Rutland Railroad Company, New York & Ottawa Railway Company, St. Lawrence & Adirondack Railway Company, Lake Shore & Michigan Southern Railway Company, Cleveland, Cincinnati, Chicago & St. Louis Railway Company, Michigan Central Railroad Company, Lake Erie & Western Railroad Company, Indiana Illinois & Iowa Railroad Company, Indiana Harbor Railroad Company, Lake Erie, Alliance & Wheeling Railroad Company, Dunkirk, Allegheny Valley & Pittsburg Railroad Company.

Mr. C. F. Daly has been appointed passenger traffic manager of lines east of Buffalo.

Mr. W. J. Lynch has been appointed passenger traffic manager of lines west.

The annual dinner and etasohrilduim

Annual Meeting and Dinner of the Electrical Trade Society of New York.

The annual meeting and dinner of the Electrical Trade Society, of New York, will be held at the Imperial Hotel, Broadway and Thirty-first street, New York city at 5.30 P. M., Tuesday, December 12. A large attendance is expected.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

MONTREAL STREET RAILWAY—The directors of the Montreal Street Railway have decided on the reorganization of the company. The capital will be increased from $7,000,000 to $12,000,000. It is intended that the par value of the shares shall be increased from $50 to $100 a share. The Park and Inland Railway, a subsidiary railway, now owes the Montreal Street Railway $800,000, and this will be refunded by the reorganization plan.

SOUTHERN BELL TELEPHONE COMPANY TO INCREASE CAPITAL STOCK—A special meeting of the stockholders of the Southern Bell Telephone and Telegraph Company has been called for December 13, to vote on a proposition to increase the capital stock from $1,000,000 to $30,000,000. It is understood that this increase is for the purpose of rehabilitating some old lines and for the purchase of a number of smaller companies.

NEW TELEPHONE COMPANY—The Central Home Telephone Company, with a capital of $5,000,000, was granted a certificate of incorporation at Dover, Del., on November 26. The new company purposes extensive operations, especially in the Middle West, both by constructing new lines and in consolidating existing local lines. The incorporators are Edward L. Barber, Wauseon, Ohio; John C. Monteith, Louisville, Ky.; John C. Monteith, Bloomington, Ind., and James E. Bergen, Nanticoke, Pa.

NEW YORK FIRM CONTROLS SAN FRANCISCO ELECTRIC CORPORATION—It has been reported that the control of the United Railroads of San Francisco (Cal.), which operate 253 miles of traction lines in that city, has changed hands. Ladenburg, Thalmann & Company, New York city, it is announced, have purchased control from Brown Brothers & Company, and it is expected that Arthur Holland, president of the company, will resign before the end of the year. Considerable interest attaches to the announcement because of the negotiations which are now pending for the purchase of traction lines in Pittsburg by the same body of financiers.

POWER PLANT FOR SALT LAKE CITY, UTAH—The Inter-Mountain Power Company, of Nevada, is preparing for the expenditure of $750,000 on the construction of reservoirs and power plants in Big and Little Cottonwood cañons, to supply power to the mines and smelters and increased water supply to Salt Lake City. The company, which has its headquarters in Salt Lake City, has filed a deed of trust with the Capital Savings and Trust Company, of Columbus, Ohio, securing first mortgage, six per cent twenty-five-year gold bonds of $500 and $1,000 each, dated August 1, 1930, the bonds to be used to pay cost of construction and equipment of the company's plant and system. The Inter-Mountain Power Company is composed of local men who already possess extensive Utah mining and other interests. J. J. Chambers is president; W. J. Craig, vice-president; C. O. Ellingwood, treasurer; Bismark Snyder, secretary, and these, with Gideon Snyder and E. J. Raddatz, constitute the directorate. The capitalization is $1,500,000.

LARGE ISSUE OF BONDS BY AMERICAN TELEPHONE AND TELEGRAPH COMPANY—The stockholders of the American Telephone and Telegraph Company will meet on December 21 to authorize the issue from time to time of $150,000,000 of convertible bonds. At the present time it has $131,551,400 of capital stock outstanding and about $88,000,000 of bonds. According to the circular which has been sent to the stockholders the bonds will be issued from time to time as business may require, with the right to convert them into stock after two and not more than twelve years at a price not less than par. No specific explanation for this bond issue is given in the circular beyond the statement that the policy of extending and developing business will require the additional capital. The circular says that the company has sufficient cash in its treasury to meet all needs until well into 1906, but that the directors believe it advisable to have authority to issue bonds in order to act quickly in case favorable opportunities arise.

PERSONAL MENTION.

MR. L. H. WALTER has prepared, in pamphlet form, a reprint of his article entitled "Some Problems in the Wireless Transmission of Signals," which appeared in a recent issue of the *Electrical Magazine*, of London.

MR. FRANK C. MASON, superintendent of police telegraph, Brooklyn, N. Y., was severely injured in his knee by the sudden starting of a trolley car as he was alighting from it on Sunday last. Mr. Mason was confined to his room for several days, and is now only able to move around on crutches.

MR. W. B. GRAHAM, superintendent of surface lines of the Brooklyn Rapid Transit Company, has retired, and, it is announced, will go to Chicago, Ill. Mr. W. O. Wood, superintendent of the elevated lines, will become assistant general manager of the company. Mr. L. V. Smith, former assistant to Mr. Wood, will be appointed superintendent in his place.

MR. H. F. STEVENS, a well-known telephone man, was tendered a banquet at the Yates House, Syracuse, N. Y., on the evening of November 22, by the officers of the Bell Telephone Company, the Central New York Telephone and Telegraph Company, the Empire State Telephone and Telegraph Company and the New York & Pennsylvania Telephone Company, of all of which companies Mr. Stevens is the general manager.

MR. CHARLES M. GOULD, treasurer of the Gould Storage Battery Company, and vice-president of the Gould Coupler Company, met with a property loss in the destruction of his extensive stable and carriage house on his estate at Bayside, L. I., Friday, December 1. That the live stock was saved was due to the heroic action of Mrs. Gould, who assisted her husband in quieting the animals and bringing them safely from the burning buildings.

MR. F. G. SYKES, electrical engineer of the Portland (Ore.) General Electric Company, has reprinted and is distributing, through the courtesy of the company, his valuable paper which was read before the electrical transmission section of the Pacific Coast Engineering Congress, descriptive of the generating and distributing system of the Portland General Electrical Company. Mr. Sykes went to Portland from Schenectady, N. Y., where he was electrical engineer for the Schenectady Railway Company. Prior to his connection with the Schenectady company, Mr. Sykes had had a very valuable training, both in this country and abroad, being well known in the early days through his connection with the Edison Company, of Brooklyn, N. Y.

EDUCATIONAL.

EVENING LECTURES AT THE UNIVERSITY OF WASHINGTON—The department of electrical engineering of the University of Washington, Seattle, Wash., has announced a course of special evening lectures during 1905-1906. These lectures are a part of the regular courses given during the year on electric railways, electric lighting and power transmission. The lecturers are Mr. Elbert G. Allen, chief electrical engineer, Seattle Electric Company; Mr. J. D. Ross, chief electrical engineer, Seattle Municipal Electric Light and Power Company; and Mr. John Harisberger, chief electrical engineer, Seattle-Tacoma Power Company.

THOMAS S. CLARKSON MEMORIAL SCHOOL OF TECHNOLOGY—The October number of the "Clarkson Bulletin," published by the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., contains the following interesting articles: "On the Study of Economics in the Clarkson School of Technology," by Director William S. Aldrich; "The Engineer in Manufacturing Industries," by Walter S. Graffam; " Home Economics in its Relation to the Individual and the State," by Myra Brewster Clarke; "Mosquitos, Malaria and Yellow Fever," by Homer M. Derr; "Some Structural Problems in the New York *Times* Building," by Charles H. Lawrence. The bulletin also contains a syllabus of courses in home economics offered by the school, and descriptions of new courses and recent appointments. The total enrolment for the present semester is seventy-one, fifty-six of these being in engineering courses, twelve in home economics and three in special studies.

TELEPHONE AND TELEGRAPH.

ARDMORE, I. T.—The Ardmore city council has granted a telephone franchise to F. B. McElroy and associates.

McINTOSH, MINN.—A. F. Cronquist has purchased the Erskine telephone system and will extend and improve it.

SAULT STE. MARIE, MICH.—Local business men have started a movement to organize an independent telephone company.

ROCKFORD, ILL.—The farmers of New Milford township have organized a telephone company with A. T. Chase as secretary.

EGG HARBOR CITY, N. J.—The Delaware & Atlantic Telephone and Telegraph Company is building a line from Greenbank to Hammonton.

BURTON, OHIO—The Burton Telephone Company is building new lines into Middlefield and extending one line south of that place toward Parkham.

SAYVILLE, N. Y.—The New York & New Jersey Telephone Company has completed the extension of its line from Sayville to Bohemia, a distance of three miles.

EDWARDSVILLE, ILL.—The Macoupin County Telephone Company has signed a contract with the Kinloch company, whereby it may connect with the Kinloch lines.

WILLIAMSPORT, PA.—The Summerville Telephone Company has completed the work of rebuilding its lines at Williamsport, and the service is now of an excellent character.

PLYMOUTH, WIS.—The Cedar Grove Telephone Company has made arrangements with the Wisconsin Telephone Company to give its subscribers in Plymouth long-distance service.

BELLEVILLE, ILL.—The Looking Glass Prairie Telephone Company will construct a system between New Baden and Mascoutah, and later extend it to Fayetteville and Freeburg.

MOORE'S HILL, IND.—The Milan Telephone Company has elected the following officers: president, J. M. Spencer; secretary, Dr. J. R. Pate; vice-president, Charles Powell; treasurer, C. W. Toole.

BINGHAMTON, N. Y.—The Lester Telephone Company has elected these directors: W. B. Twitchell, H. A. Williams, A. S. Judd, C. H. Smith, Daniel Jackson, A. H. Moore and A. H. Andrews.

ATLANTA, GA.—The petition of the Atlanta Telephone and Telegraph Company for the right to place underground conduits has been approved by the Atlanta council's committee on electric lights.

ATHENS, ILL.—The Petersburg Telephone Company is constructing a new line between Athens and Petersburg. When completed it will be used as a toll line, and the present one converted into a farmers' line.

KENOSHA, WIS.—The Chicago Telephone Company has made a general reduction of rates along the north shore, and it is stated that the rate between Kenosha and Chicago will be cut ten cents for each three minutes.

GALLIPOLIS, OHIO—The Bell Telephone Company has made arrangements to dispose of its Gallipolis plant, and a local company has been organized to operate it. The new company is known as the Home Telephone Company.

NORTHVILLE, MICH.—The Northville Telephone Company has sold its plant for $8,500 to the independent company represented by J. B. Ware, of Detroit and Grand Rapids, and R. B. McPherson, of Howell. The exchange has 260 subscribers.

SALT LAKE CITY, UTAH—Superintendent W. P. S. Hawk, of the Postal Telegraph company, states that his company has installed two additional wires from Butte to Portland, which will add to Salt Lake's telegraph facilities to the coast.

HARRISBURG, PA.—The United Telephone and Telegraph Company has sold one of its lines to the Dauphin & Schuylkill Telephone Company. The line sold is that known as the old Lykens line running from Gratz to Good Spring, a distance of twenty miles.

NASHVILLE, TENN.—A contract has been signed between the Illinois Central Railroad and the Cumberland Telephone and Telegraph Company, by which the telephone company is to equip the railroad with telephone wires from Louisville to New Orleans.

ATLANTA, GA.—The Southern Bell Telephone Company has been authorized to erect its new telephone exchange, which is to cost $75,000. The work will commence at once. The new building is to be seven stories high, but at present only four stories will be built.

HATTIESBURG, MISS.—The Jones Telephone Company, which recently procured a charter for an underground telephone system in Hattiesburg, is now engaged in constructing a long-distance line from Meridian to Hattiesburg, having completed the installation of a local plant at Meridian.

BINGHAMTON, N. Y.—At the annual meeting of the Susquehanna Telephone and Telegraph Company the following were elected for the ensuing year: directors, E. W. Jackson, Frank Zeller, M. H. Eisman, M. J. Ryan, M. J. Lannon and Dr. S. S. Simmons; auditors, Dr. J. D. Kelly, C. I. Fisher and C. E. Titsworth.

WALKER, MINN.—At the annual meeting of the Cass County Telephone Company the following were elected to office: F. W. Deline, president; J. O. Jesme, vice-president; F. H. Clayton, secretary; John Clark, treasurer. This company is a mutual organization, being composed of farmers of South Cass County.

COLORADO SPRINGS, COL.—The Home Telephone Company of Colorado City, has completed the purchase of the property taken from the El Paso Telephone Company by R. H. Handy and others under chattel mortgage, and, it is understood, will begin the immediate operation of the plant. The consideration is not given.

DECORAH, IOWA—At a recent meeting of the Festina Telephone Company the following officers were elected: Aloys Holthaus, president; Joe Boeckman, vice-president; H. A. Dessel, secretary and treasurer; board of directors, Dr. E. M. Heflin, chairman; Herman Bullerman, John Bruening, Barney Gehling and John Etteldorf.

NEW BEDFORD, MASS.—Upon the petition of the Southern Massachusetts Telephone Company for pole locations in Mattapoisett the selectmen have granted the greater part of the locations as asked for upon certain conditions, having reference mainly to protecting the trees from injury, the methods of construction and a few minor details.

WILMINGTON, DEL.—At a meeting of the board of directors of the Delmarvia Telephone Company Charles C. Kurtz, of Wilmington, former vice-president, was elected president, *vice* D. E. Evans, of Baltimore, who resigned the presidency in Mr. Kurtz's favor, Mr. Evans now becoming vice-president. It was decided at the meeting to make some extensive improvements.

PITTSBURG, PA.—The property and rights of the Carmichael Telephone Company at Carmichael and Jefferson, Greene County, have been purchased by a party of Uniontown capitalists, headed by J. V. Thompson. The Carmichael company had toll lines to Fayette County, within one mile of Waynesburg, and this loop will be completed at once. The new company will affiliate itself with the other independent interests of the section.

CARTHAGE, MO.—The purchase of all of the Southwest Telephone Company's lines by the Missouri & Kansas Telephone Company, a Bell concern, has been made public. The Southwest lines cover all of Lawrence and Barry counties and parts of Newton, McDonald and Greene counties, with large exchanges at Pierre City, Mount Vernon, Monett, and stations at most all of the other towns in the territory between Carthage and Springfield. At Aurora the Missouri & Kansas company is completing an extensive new exchange.

ZANESVILLE, OHIO—The stockholders of the Frazeysburg Independent Telephone Company, which was organized recently with a capital stock of $10,000, have elected the following board of directors: Max Frazier, Frank Shaw, Nathan Nethers, S. H. Frazier, Samuel Dorsey, Dr. W. D. Drake and J. B. Rhodes. The directors organized as follows: president, Max Frazier; vice-president, Dr. W. D. Drake; secretary and treasurer, S. H. Frazier; general manager, J. B. Rhodes; assistant general manager, Emmet McCann; general counsel, Sherman Granger. The company has purchased the Frazeysburg exchange, and all the lines owned by the Farmers and Merchants' Telephone Company in Muskingum county. A direct line will be built connecting with the Zanesville Telephone and Telegraph Company.

ELECTRIC LIGHTING.

HARTFORD, CT.—The Enfield Gas Company has acquired the Windsor Locks Electric Light Company.

ABERDEEN, S. D.—At a special election the proposition to issue $35,000 bonds for a municipal lighting plant carried.

POUGHKEEPSIE, N. Y.—Two large boilers are being installed at the plant of the Newburgh Light, Heat and Power Company.

MONROE, MICH.—At a special election the proposition to bond the city for $20,000 for a new municipal lighting plant was defeated by forty-three votes.

WINDSOR LOCKS, CT.—Burdett Loomis, acting it is believed for a party of Hartford capitalists, has purchased the plant and franchise of the Windsor Locks Electric Light Company.

WATERBURY, VT.—The Consolidated Lighting Company has secured sufficient business in Colbyville and Mill Village to warrant the extension of its wires to that section and the work is to be done at once.

LOUISVILLE, KY.—Both the electric lighting and the water plants at Jasper, Dubois County, have been purchased by the town authorities, and the capacity of the light plant has been increased by 3,000 lights.

ST. JOHN, N. B.—The Carleton Electric Light Company's property which was recently purchased by John Russell, Jr., will be transferred to the St. John Railway Company, Mr. Russell having, it is understood, sold to that company.

ROSLYN, L. I.—The Roslyn town board has accepted the bid of the Nassau Light and Power Company, to furnish lights for the new lighting district of Lakeville. There are to be not less than thirty lights, at a cost of $20 each per year.

CAMBRIDGE SPRINGS, N. Y.—A company that will furnish electric light for Cambridge Springs is building a power-house of cement block. The company will put in a 300-horse-power boiler, and expects to be ready for business April 1.

HARRISBURG, PA.—The plant of the Steelton Electric Light Company has been destroyed by fire involving a loss of $60,000, on which there is no insurance. The town of Steelton and adjacent territory depended on the company for light.

JASONVILLE, IND.—The Jasonville Electric Light Company has completed the new plant, and Jasonville is now lighted with electricity. The company is composed entirely of Jasonville people. James K. Person is president and H. S. Hyatt, secretary.

GARFIELD, WASH.—The city council of Garfield has granted a franchise to the Moscow (Ida.) Light and Power Company to light the city with electricity. Work on the line will begin January 1, 1906, and will be completed and the current turned on July 1.

ATLANTA, GA.—The Southern Light and Power Company, which has filed a petition with the city council, asking for a franchise to do a lighting, heating and power business in Atlanta, has purchased a site on which it purposes to locate its plant and offices.

BALTIMORE, MD.—The county commissioners have awarded to the Mount Washington Electric Light and Power Company the contract for furnishing about 100 electric lights in the vicinity of Hamilton and Gardenville at the rate of $25 per light for thirty-two-candle-power lamps.

TERRE HAUTE, IND.—The Terre Haute city administration will begin at once to carry into effect the will of the people, expressed by a vote of 6,400 to 3,100 in favor of a municipal lighting plant. The traction company's contract for lighting the streets has less than a year to run.

ST. LOUIS, MO.—A building permit has been issued to the Emporium Realty Company for the construction of a two-story brick power-house to cost $25,000. The building will be 40 feet by 105½ and will contain two rooms. The work will be done by the Westlake Construction Company.

SOUTH BETHLEHEM, PA.—South Bethlehem business men are carefully considering a suggestion that they organize a company and establish an electric light plant. There is a strong feeling in the town that favors, if not municipal ownership, at least the ownership of the franchise by taxpayers of the town who have money to invest.

LAWRENCE, KAN.—At the special meeting of the Lawrence city council the contract for lighting the city was awarded to the Lawrence Electric Light Company, whose bid was $5 a month per lamp for twenty-five lights to burn all night, and $4 a month per light for sixty-five lamps to burn until 12.30 A. M. The lights are to be 2,000-candle-power, and the work of installing the system is to commence immediately.

PLATTSBURG, N. Y.—Justice Henry T. Kellogg of the New York State Supreme Court has made public his decision restraining the village of Pottsdam from building a municipal electric lighting plant, permission not having been obtained from the state gas commission, although the resolution to build the plant was adopted by voters nearly three months before the law, creating the state gas commission went into effect. This is believed to be the first action brought under that law.

NIAGARA FALLS, N. Y.—The Niagara Falls Electrical Transmission Company is seeking permission for the building of its proposed power transmission line east of Lockport. The transmission company has not yet begun to purchase rights of way for its line, but is expected to do so shortly. No construction work for the proposed line has yet been started and will probably not be before spring. Franchises between Niagara Falls and Lockport have already been secured by the company.

WILMINGTON, DEL.—Officers of the new Wilmington Heat, Light and Power Company, which was recently granted a franchise for an electric lighting business, intend to begin constructing the new power plant early in the spring. Considerable detail work is now being done, and the plans for the new power plant are understood to be well under way. As the company will use the conduits which are already laid for its wires, it will take a comparatively short time to begin business after the power plant has been constructed.

NORWICH, CT.—By a unanimous vote the borough of Groton empowered its warden and burgesses to proceed with the work of purchasing property in the borough situated on the river bank suitable for the erection of buildings for an enlarged electric light plant and to purchase machinery requisite for the generation of sufficient power to supply not only electric light for the present and immediate future needs of the borough, but with on eye to the possibilities of the location within the borough of manufacturing concerns which will need the light and power thus provided.

WHATCOM, WASH.—The Whatcom County Railway and Light Company, of Bellingham, Wash., has sold enough first mortgage thirty-year, five per cent bonds to Lee, Higginson & Company, of Boston, Mass., to retire $535,000 five per cent mortgage bonds, which will be called at 105 and interest, and to purchase the Whatcom lighting plant in the old section of the city and to complete a power plant on the Nooksack river. This move will secure a monopoly of the electric and gas lighting and electric railway business of the city and the most available water power for serving the city.

PATERSON, N. J.—Representatives of the Economy Lighting Company appeared before the members of the Little Falls township committee with a proposition that they be given a franchise to construct lines in the township. The concern was recently incorporated, and will do business in Little Falls township for the present. The ordinance giving the company the right to construct lines was passed on its first reading. The incorporators of the company are as follows: H. W. Wood, Little Falls; W. C. Clift, Newark; Edwin H. Beldings, Little Falls; William Van Ness, Little Falls; Allan J. Gray, New York. The capital stock of the company is placed at $40,000, and it begins business with $21,000 paid in.

SANTA FE, N. M.—The Socorro Water, Light and Ice Company has been organized by H. O. Bursum, Elfego Baca and W. E. Martin, of Socorro, and Frank Owen, of Santa Fe, N. M. The capital stock of the company is fixed at $30,000, and the capital has all been subscribed by New Mexico citizens. The company will supply the city of Socorro with electric light and electric power. It has received the following franchises from that city: right of way through all the streets for a pole line and, if best hereafter, for a traction transportation company; also the use of the waters of the Socorro hot springs for the purpose of generating power for its light and power plant. These franchises are for fifty years. The company proposes to install a complete and up-to-date electric light system in the city, and to supply electric power to all desiring it.

NEW INCORPORATIONS.

GEORGETOWN, S. C.—Home Telephone Company. $16,000.

LENOIR, N. C.—Citizens' Light and Power Company. $25,000.

LANSING, MICH.—Elk Rapids Light and Power Company. $25,000.

ALBANY, N. Y.—Granville Telephone Company. Increased from $50,000 to $250,000.

ST. LOUIS, MO.—Electric Railway Express Company. $100,000. Capital in Illinois, $50,000.

COLUMBUS, OHIO—The Perry County Telephone Company, New Lexington. Increased from $35,000 to $50,000.

FRANKFORT, KY.—Paducah Light and Power Company; $450,000. Paducah Traction Company; $350,000.

COLUMBUS, OHIO—Cincinnati, Milford & Loveland Traction Company. Increased from $1,000,000 to $1,650,000.

SPRINGFIELD, ILL.—New Milford Telephone Company. $5,000. Incorporators: T. Evans, F. C. Pell and A. T. Chase.

AUSTIN, TEX.—Dixie Telephone Company, Bronte. $10,000. Incorporators: B. H. Rand, Bascom Lynn and D. A. Lynn.

SHAMROCK, TEX.—Walker Telephone Company. $10,000. Incorporators: J. E. Walker, Barnett Blossom and Rea Blossom.

ALBANY, N. Y.—Citizens' Lighting Company, of Oswego, $75,000. Directors: J. C. Knight, Thomas More, C. A. Bentley, of Oswego.

PORTLAND, ME.—South Porto Rico Telephone Company. $30,000. President, H. L. Cram; treasurer, A. F. Pine, both of Portland.

MADISON, WIS.—The Deerfield Telephone Company, Deerfield. $10,000. Incorporators: H. C. Winter, W. Jackson Bell and Mary J. Bell.

CHICAGO, ILL.—Hutsonville Telephone Company, Hutsonville. $3,700. Incorporators: C. D. Ryerson, C. H. Voorheis, Clinton Newlin.

EDGAR, WIS.—Edgar-Cassel-Emmet Telephone Company. $1,500. Incorporators: E. C. Barrett, Otto Fehihaber and W. W. Gamble.

WILLIAMSFIELD, ILL.—Williamsfield Trunk Line Telephone Company. $1,000. Incorporators: C. H. Pulver, J. A. Tucker and John B. Gale.

DUBLIN, TEX.—Dublin Gas and Electric Company. $50,000. Incorporators: M. B. Templeton, of Waxahachie, and J. F. Strickland, of Dallas.

SPRINGFIELD, ILL.—Spring Valley Telephone Company, Spring Valley. $10,000. Incorporators: E. M. Baysoar, S. H. Brakel and Charles W. Knapp.

MILWAUKEE, WIS.—Random Lake Telephone Company, Random Lake. $5,000. Incorporators: T. E. Malloy, T. D. Schneidler and W. B. Krause.

INDIANAPOLIS, IND.—Capital City Electric Company, of Indianapolis. $10,000. Directors: William Phipps, Lillie B. Phipps and Albert F. Egger.

GUTHRIE, OKLA.—Billings & Red Rock Telephone Company, of Billings. $30,000. Incorporators: Ray Rozella, Henry and N. J. Carter, all of Billings.

MADISON, WIS.—Brown County Telephone Company, Green Bay. $10,000. Incorporators: Henry F. Hagemeister, C. A. Straubel and Frank J. B. Duchateau.

ALBANY, N. Y.—Cornwall Telephone Company, Cornwall-on-Hudson. $5,000. Directors: W. B. Goodwin, Leonard Hand, G. Morrell, New York city.

LOS ANGELES, CAL.—Jurupa Water, Light and Power Company. $200,000. Directors: F. W. Pickard, J. B. Samuel, Herbert L. Cornish, of Los Angeles.

AUSTIN, TEX.—South Texas Telephone Company. $400,000. To operate in about fifty counties in the state of Texas. Incorporators: J. A. Quesenberry, Danville, Ky.; A. E. Schaefer, Wapakoneta, Ohio; J. E. Boynton, Waco; F. C. Smith, San Antonio, and W. B. Stephens, San Antonio.

DOVER, DEL.—Riverton & Delmar Telephone Company. To construct and operate a system of telephone and telegraph lines in the state of Delaware. $50,000.

COLUMBUS, OHIO—Stillwater Mutual Telephone Company, Flushing. $5,000. Incorporators: A. W. Collins, M. O. White, T. J. Murphy, Fred A. Groves, J. H. Smith.

SALT LAKE CITY, UTAH—Grand Canyon Power Company. $100,000. O. S. Buell, president and secretary; H. M. Bowers, vice-president; George Havecamp, treasurer.

RICHMOND, VA.—Interstate Street Railway Company, Bristol. $5,000. Incorporators: H. Morrison, president, Richmond; D. M. Bernard, secretary and treasurer, Bristol.

LOUISIANA, MO.—Pike County Light and Power Company, of Bowling Green. $7,000. Incorporators: Noah H. Ledford, Annie D. Ledford, S. Sparrow and Isham C. Dempsey.

COLUMBUS, OHIO—Bradley Light, Heat and Power Company, Cleveland. $1,000. Incorporators: U. A. Bradley, George Lillis, J. C. Burgess, C. B. Marty, Frank B. Masters.

NASHVILLE, TENN.—Farmers and Merchants' Telephone Company, Stewart County. $500. Incorporators: H. A. Cansey, F. P. Edwards, Joe Gray, S. B. Hayes and Joe Melton.

SALEM, ORE.—Portland-Salem Electric Railway Company. To build an electric railway from Salem to Portland. $100,000. Incorporators: W. J. Walsh, L. H. Cordes and H. Dunn.

PORTLAND, ME.—Bahia Gas and Electric Company. To deal in gas and electricity. $3,500,000. President, J. J. Hernan; treasurer, J. L. Brophy; clerk, M. W. Baldwin, all of Portland.

GALESBURG, ILL.—People's Electric Power Company. To operate light, heat and power plants. $2,500. Incorporators: Charles S. Harris, Addison P. Higgins and Frank W. Harris.

BATH, N. Y.—Bradford Telephone Company. To operate between Bath, Savona and Bradford. $2,000. Directors: T. W. Chase, Bath; F. S. Ovenshire, Urbano, and Edgar Sanford, Bradford.

AUGUSTA, ME.—Northern Texas Electric Company. To engage in the lighting and heating business. $5,000,000. Officers: L. Barton, president, Portland, and J. H. Ridge, of the same city, treasurer.

MINNEAPOLIS, MINN.—Tri-County Telephone Company, New Prague. To serve Scott, Le Sueur and Rice counties. $100,000. Incorporators: S. A. Votapek, Albert Rybak, and A. J. Edgerton, all of New Prague.

NASHVILLE, TENN.—Oliver-Stewart Company. To construct a power plant on the Tennessee river, thirty miles from Chattanooga. $25,000. Incorporators: R. L. Sites, B. R. Stout, W. L. Smith, J. C. Harris and Walter S. Roberts.

GUTHRIE, OKLA.—The Farmers' Mutual Telephone Exchange, Custer County. $2,500. Directors: R. X. Wade, W. T. Bradley, J. T. Bradley, C. H. Taylor, D. E. Carper, D. H. Buschman, J. S. Wilkes, J. H. Anderson and W. M. Stone, all of Weatherford.

UNIONTOWN, PA.—Uniontown & Waynesburg Street Railway Company. $120,000. Incorporators: J. V. Thompson, George L. Hibbs, Frederick C. Keighley, J. M. Hustead, D. F. Maroney, I. W. Semans, J. E. Barnes, J. R. Barnes and A. J. Cochran.

JERSEY CITY, N. J.—The Quito Electric Light and Power Company. To manufacture and distribute electric current for light, heat and power, etc. $400,000. Incorporators: William B. F. Rogers, F. Angelo Gaynor, John T. Smith, Jersey City.

RICHMOND, VA.—The Gate City Telephone Company. Principal office, Gate City, Scott County. $5,000. Incorporators: O. H. Gobble, president, Clinchport, Va.; W. D. Smith, vice-president, Gate City, Va.; J. M. Minnich, secretary and treasurer, Gate City, Va.

TORONTO, ONTARIO—Canadian District Heating Company, Hamilton. To construct, maintain, complete and operate works for

the production, sale and distribution of electricity, gas, steam, and hot water, for the purpose of light, heat and power. $250,000. Incorporators: W. W. Stewart, W. P. Stewart, W. P. Witton, W. J. Clark, R. B. Griffith, all of Hamilton, and John H. Williamson, Toronto.

HARTFORD CITY, IND.—Marion, Hartford City & Eastern Railroad. $25,000. To be increased to $1,000,000 upon the completion of the road. Incorporators: W. B. Dodds, of Marion; J. L. and Oscar A. Thompson, of Gas City; C. A. Brashear, of Gas City; Fred R. Chandler, of Muncie.

RICHMOND, VA.—United Frederick & Clarke Telephone Company, Frederick County, Va. $1,000. Incorporators: J. H. Funkhouser, president, Clarke County, Va.; P. H. Funkhouser, secretary and treasurer, and J. S. Haldeman, the latter a stockholder, both of Frederick County, Va.

GUTHRIE, OKLA.—The United Telephone and Telegraph Company, Elk City. $100,000. Incorporators: G. F. Patterson, M. F. Spurlock, E. M. Scannell, Charles McLoud, T. J. Baldwin, Joe Scannell and M. Scannell, all of Elk City; W. T. Patterson and E. M. Scannell, Weatherford.

PORTLAND, ME.—The Lovell Telephone and Telegraph Company, of Center Lovell. For the purpose of building and maintaining telephone and telegraph lines on certain roads in the town of Lovell, Oxford County. $5,000. Officers: president, C. P. Hubbard, of Lovell; treasurer, J. Q. Mason, of North Lovell.

AUGUSTA, ME.—Paducah Traction and Light Company. Organized at Portland, for the purpose of doing a general lighting, heating, power, railroad and street, suburban and interurban railway business, etc. $2,000,000. Officers: president, Eugene L. Bodge, of Portland; treasurer, John H. Ridge, of Portland.

HELENA, MONT.—Toledo Mining and Power Company. To engage in a general mining, electric and power business. $500,000. Incorporators: L. D. McCall, of Chicago; W. A. Stanton, of Chicago; C. W. Foster, of Chicago; H. M. Blossom, of St. Louis; H. E. Langdon, of Cincinnati; G. J. Renner, of Youngstown, Ohio, and J. J. Schubert, of Kankakee, Ill.

JOLIET, ILL.—Joliet & Southern Traction Company, Joliet. To construct a line from Joliet, Will county, Ill., in a southwesterly direction, through the counties of Will, Grundy and Livingston, to Dwight, Livingston county, Ill. $10,000. Incorporators and first board of directors: H. A. Fisher, F. E. Fisher, L. D. Fisher, F. E. Stoddard, all of Joliet, Ill.

INDIANAPOLIS, IND.—Chicago, Kankakee & Lafayette Southeastern Traction Company. $100,000. To build a line from Lafayette to Kankakee, connecting at the latter place with a line to Chicago. Directors: W. N. Harding, Martin Hugg, E. M. Cooper, James S. Cruse, Burton E. Parrott, A. P. Hendrickson, of Indianapolis; Dan W. Sims, of Lafayette, and W. S. Reed, of Chicago.

ENGINEERING SOCIETIES.

PHILADELPHIA SECTION OF THE AMERICAN ELECTROCHEMICAL SOCIETY—A regular monthly meeting of the Philadelphia section of the American Electrochemical Society was held on Saturday, December 2, at 8 P. M. Abstracts of a number of recent electrochemical papers were read and discussed.

AMERICAN ELECTROCHEMICAL SOCIETY—At a meeting of the board of directors of the American Electrochemical Society, held November 4, the following applicants were elected to membership: Leonard Waldo, Plainfield, N. J.; W. B. Jadden, Marion, Ind.; William Smith, Philadelphia, Pa.; Carl P. Goepel, New York city.

THE RAILWAY SIGNAL ASSOCIATION—The proceedings of the Railway Signal Association for 1905 will be issued December 12. The proceedings are replete with interesting information pertaining to signals. The various committee reports and papers written during the year are reprinted, together with all of the relative discussion. Mr. H. S. Balliet, Grand Central station, New York city, is secretary-treasurer.

ELECTRICAL SECURITIES.

It is believed in many quarters that the market is close to a turning point, following the recent spectacular advance. Last week prices moved irregularly, and the market might be characterized as extremely dull. Public interest and operation have shown small change. In fact, many commission houses are now deploring the apathy with which the public is considering speculation. The reopening of Congress for the fifty-ninth session, and the reception of a message from the President, will, no doubt, serve as a beginning for a new line of thought, and the propositions outlined in the annual message will very likely establish some definite conclusion with regard to probable legislation in the all-important rate regulation matters.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 2.

New York:	*Closing.*
Brooklyn Rapid Transit	85⅜
Consolidated Gas	175
General Electric	183½
Interborough Rapid Transit	210
Kings County Electric	200
Manhattan Elevated	163
Metropolitan Street Railway	118½
New York & New Jersey Telephone	150
Westinghouse Manufacturing Company	190

The directors of the General Electric Company have declared the regular quarterly dividend of 2 per cent payable January 15 to stockholders of record on December 15.

Boston:	*Closing.*
American Telephone and Telegraph	136
Edison Electric Illuminating	243
Massachusetts Electric	59
New England Telephone	134
Western Telephone and Telegraph preferred	90

The earnings of the Massachusetts Electric Companies for the first two months of the new fiscal year are reported to be far in excess of last year in both gross and net.

Philadelphia:	*Closing.*
Electric Company of America	11½
Electric Storage Battery common	79
Electric Storage Battery preferred	79
Philadelphia Electric	8⅜
Philadelphia Rapid Transit	31½
United Gas Improvement	92¾

The Electric Company of America announces an allotment of 10 per cent of new stock at par as of record of December 12. The proceeds of the allotment, about $407,780, will be used to reimburse the company in part for money spent in acquiring the Indiana plants and on their subsequent improvement, thus placing surplus cash in the treasury to take over new properties, etc.

Chicago:	*Closing.*
Chicago Telephone	135
Chicago Edison Light	161
Metropolitan Elevated preferred	70
National Carbon common	78
National Carbon preferred	117
Union Traction common	11
Union Traction preferred	37

The Northwestern Elevated daily average of passengers carried for November is 83,597, an increase of 9,290.

The daily average passenger traffic on the Metropolitan Elevated for November was 132,276, an increase of 16,473.

The South Side Elevated reports almost an 8 per cent gain for November, the daily average of passengers having been 92,156, an increase of 6,996.

OBITUARY NOTICE.

MR. WILLIAM H. EDGAR, who died at Hot Springs, Va., Sunday evening, November 26, was buried at Oakwood Cemetery, Chicago, Ill., November 29. Mr. Edgar was a well-known business man of Chicago. He was born in Chicago in 1865, and received his early education in the schools of that city. Upon arriving at manhood he founded the Dearborn Drug and Chemical Works, of which he was president. He was a member of the Chicago Athletic Association, several lodges of the Masonic order, and the order of Elks.

ELECTRIC RAILWAYS.

TURNER, ME.—The new electric road between Turner and Auburn has been opened for service. The road is ten miles long, and is estimated to have cost $160,000.

NEWBURGH, N. Y.—A new trolley line is projected, extending from Ossining to the new Croton dam, thence to Croton, Oscawana, Crugers, Montrose and Verplanck's Point.

WASHINGTON, PA.—The West Washington borough council has granted a franchise to the Washington & Claysville Street Railway Company to occupy two of the main thoroughfares.

CONNELLSVILLE, PA.—The West Penn Railways Company has secured all the rights of way between Mount Pleasant and Youngwood for the building of the new line in that section.

MILWAUKEE, WIS.—John Farson announces that he is now sole owner of the Janesville, Beloit & Rockford Interurban Company, and that he intends to extend the line to Madison.

SANTA CRUZ, CAL.—Plans have been made and rights of way are now being bought for an extension of the Santa Cruz, Capitola & Waterville electric railway from Capitola to Soquel.

MARTINS FERRY, OHIO—The Wheeling Traction Company has awarded to T. J. Stringer the contract for building its new line which will follow the county road from Mingo to Steubenville.

LEBANON, PA.—The Conestoga Traction Company, building a trolley line between Lancaster and Mount Joy, a distance of twelve miles, has completed the line from Lancaster to Landisville.

SHERMAN, TEX.—Local officials of the company to construct and operate the proposed electric line from Sherman to Gainesville announce that the contract has been awarded and that work will begin soon.

EVANSVILLE, IND.—The Evansville & Henderson Electric Railway has been granted an extension of one year on its franchise by the Evansville city council. The company proposes a road to Owensboro, Ky.

SAN JOSE, CAL.—The Alum Rock and San Jose-Santa Clara roads have been sold to John Martin, of the California Gas and Construction Company. The purchase price was $650,000, of which $400,000 is in bonds.

NEW HAVEN, CT.—A deed recording the sale of the property of the New Haven & Derby Railroad Company to the New York, New Haven & Hartford Railroad Company has been filed. The consideration is $764,370.

OKLAHOMA CITY, OKLA.—The Oklahoma City city council has granted a franchise to the Oklahoma Interurban Traction Company to construct a line of road in the city, using certain streets in the southern portion of the city.

SAN RAFAEL, CAL.—Deeds for a right of way nine miles long from Los Gallinas Creek to Point San Pedro for an electric railway have been filed. The property was transferred by John A. McNear to John Sanford, representing the Petaluma & Santa Rosa Railroad.

BUCYRUS, OHIO—A franchise has been granted by the county commissioners to the Galion & Southeastern Electric Railway. The line will extend from Galion to Mount Vernon, putting Bucyrus in connection with Mount Vernon. The new line runs through a territory without any steam or electric railway.

TRENTON, N. J.—The secretary of state has filed for the Hudson & Manhattan Railway Company a certificate abandoning one of its proposed branch lines on which no work has been done, and an amended survey and description of a branch line from Jersey City to Newark which is to be substituted therefor.

GREENSBURG, PA.—The granting of a charter to the Greensburg & Herminie Railway Company ensures the building of a trolley line from Greensburg to that mining settlement in a short time. The company is composed of Congressman George F. Huff, county treasurer-elect Harry L. Bovard, Colonel L. B. Huff and others.

OTTAWA, ONTARIO—Detroit capitalists are largely interested in an electric road now building from Detroit through Windsor, Leamington, Chatham, London, and thence to Buffalo. It will be an outgrowth of the Windsor & Lake Shore Electric Railway. When Detroit and Buffalo are connected the power from Niagara Falls will be utilized.

SAN JOSE, CAL.—An electric railway from San Jose to Alviso and Dumbarton Point, connecting with a line of steamers at the latter place for San Francisco probably will be built within a year. It is said that Hugh Center, who recently sold his interest in the San Jose-Santa Clara Electric Railway, with San Francisco capitalists, will build the road.

ST. LOUIS, MO.—The franchise sought by the St. Louis, Fern Ridge & Western Railway Company for a street railroad out the Olive street road to Creve Cœur lake has been granted by the St. Louis county court. It is claimed that the proposition is backed principally by St. Louis county capitalists, who are securing the privilege with the intention of constructing the road.

LOUISVILLE, KY.—Officers of the Louisville & Southern Indiana Traction Company announce that it will extend its line, now connecting Louisville, New Albany and Jeffersonville, to Charleston, Ind., twelve miles from Louisville. The new line will ultimately be extended to North Vernon, Ind. There it will connect with lines to Seymour, Columbus, Franklin, Indianapolis and smaller towns.

BALTIMORE, MD.—The Washington, Baltimore & Annapolis Electric Railway Company, which proposes to operate an interurban service between Washington and Baltimore, and later to Annapolis, has purchased a site in the heart of Baltimore for its terminal station. The new station, which will be located at the corner of German, Liberty and Hopkins streets, is planned to be one of the finest buildings of the new Baltimore.

PHILADELPHIA, PA.—At a meeting of the directors of the Hanover Central Railroad Company it was decided to extend the road in Hanover township, Lehigh County; Hanover township, Northumberland County, and Upper Nazareth, East Allen, Lower Nazareth and Nazareth. The extension will begin at Gruber's Corner, thence to Schoenersville, Parson's Corner, Steuben Station, Georgetown and Nazareth, all in Pennsylvania.

MARION, IND.—At a meeting of the stockholders of the Marion, Hartford City & Eastern Traction Company, the following directors were named: John L. Thompson, Oscar Thompson and Richard A. Brashear, of Gas City; William B. Dodds, Marion, and F. R. Chandler, of Muncie. The board of directors elected officers as follows: president, John L. Thompson; vice-president, William B. Dodds; secretary and treasurer, R. A. Brashear.

COLUMBUS, OHIO—The line of the Columbus, Delaware & Marion road will be extended from Marion to Bucyrus during the coming winter. At a meeting held at Bucyrus it was announced that rights of way had been secured between Marion and Bucyrus and that work on the extension would be started at once. When the line from Marion to Bucyrus is built there will be direct trolley communication between Columbus and Cleveland.

WABASH, IND.—The Fort Wayne & Wabash Valley Traction Company has concluded a deal whereby it comes into possession of twenty miles of completed grade of the Muncie, Hartford & Fort Wayne north from Bluffton to the point of junction with the Wabash Valley. The Muncie, Hartford & Fort Wayne will not extend beyond Bluffton, and the Wabash Valley will operate the property acquired as part of its new line from Fort Wayne to Indianapolis, to be constructed next year.

NEWPORT NEWS, VA.—The property of the Hampton Roads Railway and Electric Company has been turned over to the Hampton Roads Traction Company, the concern organized by the bondholders who recently bought the property in at public auction. The officers of the new company are: president, Horace A. Doane; vice-president, Walter Holliday; secretary, W. G. Browning; directors, Horace A. Doane, Walter Holliday, W. G. Browning, Edward G. Powell, L. G. Crenshaw, Murray McGuire and Oscar Cranz.

LAFAYETTE, IND.—Citizens of Jackson township at Odell, fifteen miles south of Lafayette, have voted almost unanimously in favor of lending assistance to the project to extend the Fountain-Warren Traction Company's tracks from Danville, Ill., to Lafayette. The line, if built, will pass through Jackson township and give that locality direct communication with Lafayette. A committee

was appointed to raise enough to purchase whatever portion of the right of way may be necessary, and large contributions have been secured.

ZANESVILLE, OHIO—The stockholders of the Southeastern Ohio Railway, Light and Power Company have elected a board of directors as follows: Colonel C. B. Hart, the Hon. Alfred Caldwell and Fred C. Hoffmann, of Wheeling; William Lipphardt, of Martin's Ferry; W. B. Hiteshew, E. R. Meyer and J. C. Saner, of Zanesville. The directors organized by electing Colonel C. B. Hart, president; William Lipphardt, vice-president; W. H. Neikirk, secretary-treasurer. It is announced that the interurban line between Zanesville and Crooksville will be completed and cars will be running by the latter part of next February.

LOUISVILLE, KY.—The Louisville & Indianapolis Traction Company has secured franchises through Clark, Scott and Jackson counties, Indiana, and every incorporated town from Jeffersonville to Seymour, between which cities the road is to run. The special benefits of the franchise require that the road shall be built within two years, and that work must be begun in one year. The road will be the connecting link between Indianapolis and Louisville, a line having already been completed as far south as Columbus. This leaves only eighteen miles to be built to Seymour, for which no contract has been let. From Jeffersonville to Seymour is forty-three miles, and the estimated cost of building and equipping the road is $2,000,000.

ALLENTOWN, PA.—A controlling interest in the Allentown & Reading Traction Company, whose thirty-four miles of trolley line extend from Allentown to Temple by way of Kutztown, has been bought by the Pennsylvania Railroad Company. The Pennsylvania, it is understood, will come to Allentown by this route, the Berks County terminal of which is a few miles from Reading and the Pennsylvania's Schuylkill Valley branch. The trolley line parallels the East Penn branch of the Reading Railway. The company was chartered April 25, 1903, with a capital of $250,000. The cost of the road and equipment was $951,000. Its bonded indebtedness is the smallest per mile of any trolley line in Pennsylvania.

SISTERSVILLE, W. VA.—The Parkersburg & Ohio Valley traction line from Sistersville, down the Ohio river, is to be built. The original projectors built trestles and did extensive grading before funds were exhausted. No rails were laid. Arrangements have been made to finance the road by Chicago and New York capitalists. The building of the road is an important link in the Ohio Valley chain. From Sistersville to New Martinsville there is a line that has recently been extended. There is but a short break to Moundsville and from there almost continuous traction lines to Pittsburg *via* Steubenville and East Liverpool. South of the terminus of the new line there is but a short link missing to connect with Williamson and Parkersburg.

NEW MANUFACTURING AND CONSTRUCTING COMPANIES.

DES MOINES, IOWA—The Dodd & Struthers Electrical Company has been organized with a capital of $10,000.

NEW YORK, N. Y.—The Electric Time Switch Company has been incorporated with a capital of $100,000 by A. L. Spiegel, Louis Spiegel and Adolph Fanto, New York city.

COLUMBUS, OHIO—The United States Electrical Tool Company, Cincinnati, has been incorporated with a capital stock of $25,000, by William A. McCullum, D. J. Hauss, John A. Smith, Charles F. Kleinschmidt and G. H. Feltes.

DOVER, DEL.—A certificate of incorporation has been filed for the Western Railway Construction Company, of Wagner, S. D., to construct, maintain and operate railways of all kinds and descriptions. The capital stock is $100,000.

NEW YORK, N. Y.—The John F. Allen Company, with a capital of $15,000, has been incorporated to engage in mechanical and electrical engineering. The incorporators are John H. Allen, Brooklyn; Watson B. Robinson, A. A. Byrne, New York city.

LOS ANGELES, CAL.—The Home Telephone Construction Company, Los Angeles, has been organized with the following directors: Carl L. Doran, C. G. Andrews, Philo Jones, M. Andrews, J. G. Doran, Los Angeles. The capital stock is $500,000, with $1,500 subscribed.

DOVER, DEL.—Articles of incorporation have been filed for the Traction Construction Company, of Cleveland, Ohio, to do a general contracting and construction business. The incorporators are: Frank H. Ginn, John M. Gardfield and Gardner Abbott, all of Cleveland. Capital stock, $2,000.

ALBANY, N. Y.—The New York Die Company has been incorporated with a capital of $25,000, to act as mechanical and electrical engineer, and to engage in the making of dies and tools. The incorporators are: Lewis J. Doolittle, Howard W. Forsyth, New York city; William A. Babson, South Orange, N. J.

CAMDEN, N. J.—Under the name the Atlantic City Construction Company, articles of incorporation have been filed by a trolley and steam road-building concern in the county clerk's office. The capital stock is $10,000, and the incorporators are J. A. MacPeak, William F. Eidell and F. R. Hansell.

KNOXVILLE, TENN.—The stockholders of the Electric Supply and Construction Company, recently incorporated for $25,000, have organized with the following officers: W. W. Scarborough, president and treasurer; W. J. Radcliffe, secretary and general manager. The company will do a general contracting and supply business.

HARTFORD, CT.—The Arknot Company, of Hartford, has filed a certificate with the state secretary. The company will make and deal in devices for the generation, storage, control, transmission and utilization of electricity, etc. Joseph Sachs, L. P. Waldo Marvin and Charles E. Parker are the incorporators. The authorized capital stock is $75,000.

BROCKTON, MASS.—The Tremaine Electrical Company has been incorporated with a capital stock of $4,000. It is stated that the company is to carry on a general electrical and gas construction business. Organization has been effected with Arthur H. Andrews as president, Herbert N. Davis as clerk and John A. Brackett, of Lawrence, as treasurer.

ROCHESTER, N. Y.—The American Automatic Telephone Company has been incorporated at Albany. Its principal offices are in Rochester, and it is planned to erect a factory for the construction of a device to do away with the central operator. The company is capitalized at $1,500,000. Charles L. Goodrum and J. W. Lattig are the inventors of the device.

TROY, N. Y.—The Betts Electric and Reduction Company, Troy, has filed articles of incorporation with the secretary of state to transact a general electric business. Aside from dealing in electrical supplies, the company may purchase or lease mines and manufacture and deal in chemicals and minerals. Its capital is $100,000. Directors: Anson Gardener Betts, Troy, and Benjamin Martus and W. H. Scofield, New York.

ALBANY, N. Y.—The Niagara Falls Construction and Supply Company, of Niagara Falls, has been incorporated with the secretary of state, with a capital of $10,000, consisting of share of $100 each. Of this amount the sum of $3,000 is to be ten per cent non-cumulative preferred stock. The directors for the first year are as follows: Charles B. Hyde, F. G. Anderson and Arthur Killian, of Niagara Falls.

JEFFERSON CITY, MO.—The Kansas City Electrical and Supply Company, of Kansas City, has been incorporated with a capital of $50,000, one-half of which is paid in. The incorporators are G. H. Spangle, of Chetopa, Kan.; Carl Graeber, of Lawrence, Kan.; W. A. Thoelen, of Leavenworth, Kan.; Charles E. Wells, of Marion, Kan.; William F. Sikes, of Wellington, Kan.; Edward L. Scott, P. B. Chaney, and W. L. Hutchison.

RUTLAND, VT.—Announcement is made of the organization of the Vermont Improvement Company, with G. Tracey Rogers, president of the Binghamton Street Railway Company, as president: Leo H. Wise, of New York, vice-president, and C. H. West, of Rutland, secretary and treasurer. The corporation starts with a capital of $100,000 and has a charter, with unlimited power, to deal in electric roads all over the state.

INDUSTRIAL ITEMS.

THE LOWE ELECTRIC COMPANY, New York city, has moved to its new store at 54 Vesey street.

THE PITTSBURGH TRANSFORMER COMPANY, Pittsburgh, Pa., has prepared a bulletin descriptive of the new 1906 thawing outfit.

THE HICKS LOCOMOTIVE AND CAR WORKS, Chicago, Ill., is distributing a very useful and attractive souvenir paper-weight in the shape of a miniature locomotive.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., in bulletin No. 27, illustrates and describes Fielding receptacles and rosettes for window lighting, and a new line of weatherproof socket plugs.

THE F. D. LAWRENCE COMPANY, Cincinnati, Ohio, has grown so rapidly during the past year that it is compelled to arrange for more floor and salesroom space, though it has increased in this respect several times within the past three years.

THE CLARK ELECTRIC AND MANUFACTURING COMPANY, 26 Cortlandt street, New York city, is distributing a series of bulletins describing Clark standard insulator clamps, interlocking insulator clamps of various types, and underlocking insulator clamps.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has issued a handsome catalogue dealing with crushing rolls. In addition to the very comprehensive descriptive data, there are numerous half-tone illustrations of the assembled machines and various parts.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Tremonton, Utah; Columbus, Ohio; Robinson, Ill.; Lakewood, Ill.; Chillicothe, Mo.; Garland, Utah.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has issued a handsome catalogue descriptive of coal-handling machinery for mines. In addition to views of typical installations there are numerous diagram and outline drawings showing the method of installation.

THE ELECTRO-DYNAMIC COMPANY, Bayonne, N. J., will exhibit an "Interpole" variable-speed motor, driving another motor as a generator, at the Madison Square Garden electrical show, December 12-23. An opportunity will be given to note the facility with which speed variations are obtained.

THE STANDARD ROLLER BEARING COMPANY, Forty-eighth street and Girard avenue, Philadelphia, Pa., in catalogue No. 12 describes and illustrates ball and roller bearings. In addition to the descriptive matter and price lists there are added several pages bearing engineering data of various character.

THE OTIS ELEVATOR COMPANY, New York, N. Y., has published a handsome catalogue describing and illustrating its electric elevators and hoists and hydraulic elevators. The company has installed over 20,000 electric elevators. The Otis electric elevator, with push-button control, has made a record for popularity for apartment-house passenger service.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., is distributing some new and attractive literature. Instruction book No. 3022 deals entirely with type M multiphase induction motors; bulletin No. 1971, small power motors; bulletin No. 1072, type S single-phase motors; bulletin No. 1074, multiphase, induction, integrating type K wattmeters.

THE C. HOLSCHER ELECTRIC MANUFACTURING COMPANY, Warren, Ohio, is manufacturing incandescent lamps. The company is not a member of the Association of Licensed Incandescent Lamp Manufacturers, and Mr. C. Holscher states that his company is operating under a patent granted May 23, 1905, covering an improved chemical process for exhausting lamps.

THE AMERICAN ARC LAMP COMPANY, Kalamazoo, Mich., is the subject of a very handsome article in the issue of the Kalamazoo *Gazette* for Sunday, November 26. In addition to a description of the lamp and the manufacturing equipment, there are personal sketches and portraits of Mr. Walter Ramsey and Mr. Charles M. Rose, both of whom have taken a prominent part in the development and organization of the company.

J. G. WHITE & COMPANY, 43 Exchange place, New York city, has secured the contract to do all the clearing, grading, tracklaying and building of the steel bridges and viaducts for a steam railroad running from MacKay's Ferry to Beaufort, N. C., which will be built for the Virginia & Carolina Coast Railway Company. The road will extend a total length of approximately 120 miles.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is mailing a large card bearing an illustration of the United States Express Building as it will appear when completed at Rector and Greenwich streets and Trinity place, New York city. Clinton & Russell are the architects, and the Thompson-Starret Company, the contractor on this building. The steel work, now in course of erection, is being protected with Dixon's silica graphite paint in dark red and olive green colors.

THE L. B. ALLEN COMPANY, INCORPORATED, Chicago, Ill., manufacturer of the Allen soldering compounds and commutator lubricant, takes exception to the statement appearing in a recent issue of the ELECTRICAL REVIEW, wherein it was stated that through its advertising it had built up a very good business. The company announces that it was not wholly paper advertising that has built up the business, but that its ability to deliver the goods and keep all of its promises has been the greatest impetus to its trade.

THE WARREN ELECTRIC MANUFACTURING COMPANY, Sandusky, Ohio—In the issue of the ELECTRICAL REVIEW for November 4, it was stated that the Warren Electric Manufacturing Company had been placed in the hands of a receiver. Inasmuch as the title of this company very closely approximates those of a number of well-known companies in Warren, it has been suggested that assurance be given that the Warren Electric Manufacturing Company is in no wise connected with any of the electrical companies located at Warren, Ohio.

THE OSWEGO BOILER WORKS, Oswego, N. Y., has been purchased by New York parties understood to be associated with the A. D. Granger Company, Incorporated, 95 Liberty street, New York city, with branches at Philadelphia and Pittsburg, Pa. The plant, which occupies about twenty acres on the lake front, was established some twelve years ago, and it is expected that operation will begin at once. Steel-plate work in all branches, including boilers, tanks and stacks, will be undertaken. The new company will be known as the Oswego Boiler and Engine Company, with the main office at Oswego, N. Y.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has issued bulletin No. 3107 and bulletin No. 3953, describing, respectively, single-phase induction motors and electric bottle washers. The electric bottle washers are for cleaning bottles and arc lamp globes. The machine consists of a one-fifth-horse-power motor with a cast-iron bracket for attaching to the tub or sink. The shaft is fitted with an extension to receive a brush spindle. The end of the motor at which the washing is performed is provided with a special housing and bearing to prevent the motor from injury from waste water or by dampness incident to the operation of the machine.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has recently placed on the market a storage battery charging receptacle having many advantageous features, among the more important being a swivel attachment which conforms the receptacle to standard steam railway practice, and allows the car or vehicle to start and pull out the cables without danger of breaking them or the contacts. The apparatus is adapted to both railway and automobile service, and has been adopted by the Pennsylvania Railroad for charging the batteries of its cars. The Westinghouse company has perfected a new line of three-phase core-type transformers for sixty-cycle circuits. One of these transformers may be used where three-phase transformation is to be made, instead of two or three of the single-phase type. They are self-contained units of compact construction, and are generally easier to install, and reduce the complexity of wiring between the transformer and the apparatus which it is to supply.